Hill Street Intersection Improvement

Single Stage Business Case

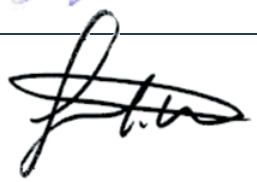
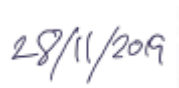
6 November 2019

(For Transmittal to NZ Transport Agency)

Auckland Transport
An Auckland Council Organisation

The Hill Street Intersection Single Stage Business Case report was prepared by Mott MacDonald NZ Ltd on behalf of Auckland Transport and the NZ Transport Agency

Business Case Approval

ROLE	NAME	SIGNATURE	DATE
RECOMMENDED:			
Project Sponsor	John Stokes		8/11/2019
Delivery Manager North West	Richard Firth		13/11/2019
Portfolio Delivery Director (Projects)	David Nelson		14/11/2019
ENDORSED:			
Business Owner (AT) & PCG Chair	**Chris Morgan** GM Strategic Projects		
ENDORSED:			
Senior User/Client (NZTA)	**Paul Glucina** Systems Design Portfolio Manager - Auckland		

MOTT MACDONALD

Hill Street Intersection Improvements

Single Stage Business Case

25 October 2019

Mott MacDonald
Mason Bros. Building
Level 2, 139 Pakenham
Street West
Wynyard Quarter
Auckland 1010
PO Box 37525, Parnell,
1151
New Zealand

T +64 (0)9 375 2400
mottmac.com

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Mott MacDonald New Zealand Limited
Registered in New Zealand no. 3338812

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Contents

Executive Summary

Auckland Transport (AT) and the New Zealand Transport Agency (NZTA) are working jointly in the investigation of future improvements to the Hill Street intersection in Warkworth to address congestion, issues with access, reliability and resilience, safety concerns and a lack of safe and convenient facilities for all users travelling through the intersection.

Investigations carried out in the past intended to resolve these same issues, however, significant changes to the transport and land use context of Warkworth are already taking place and more changes are anticipated over the next 30 years. The on-going construction of Ara Tūhono – Pūhoi to Warkworth (P2Wk) and the impending construction of Matakana Link Road (MLR) are some of the significant transport projects in the area. Warkworth is also expected to cater for more growth within the Future Urban zone areas surrounding the town which is anticipated to accommodate approximately 7,500 additional dwellings and an additional 20,000 people and new employment areas over the next three decades. This business case aims to recommend a solution to the Hill Street intersection that reflects these changes.

This Single Stage Business Case:

- ensures that the problems and potential benefits are well understood by stakeholders;
- confirms the need for investing in a mid-to-long term solution;
- identifies a Recommended Option for addressing the problems and achieving the desired benefits;
- sets out a detailed analysis of the costs, risks and benefits of the Recommended Option; and
- describes the financial, commercial and management cases for the activity.

The Case for the Project

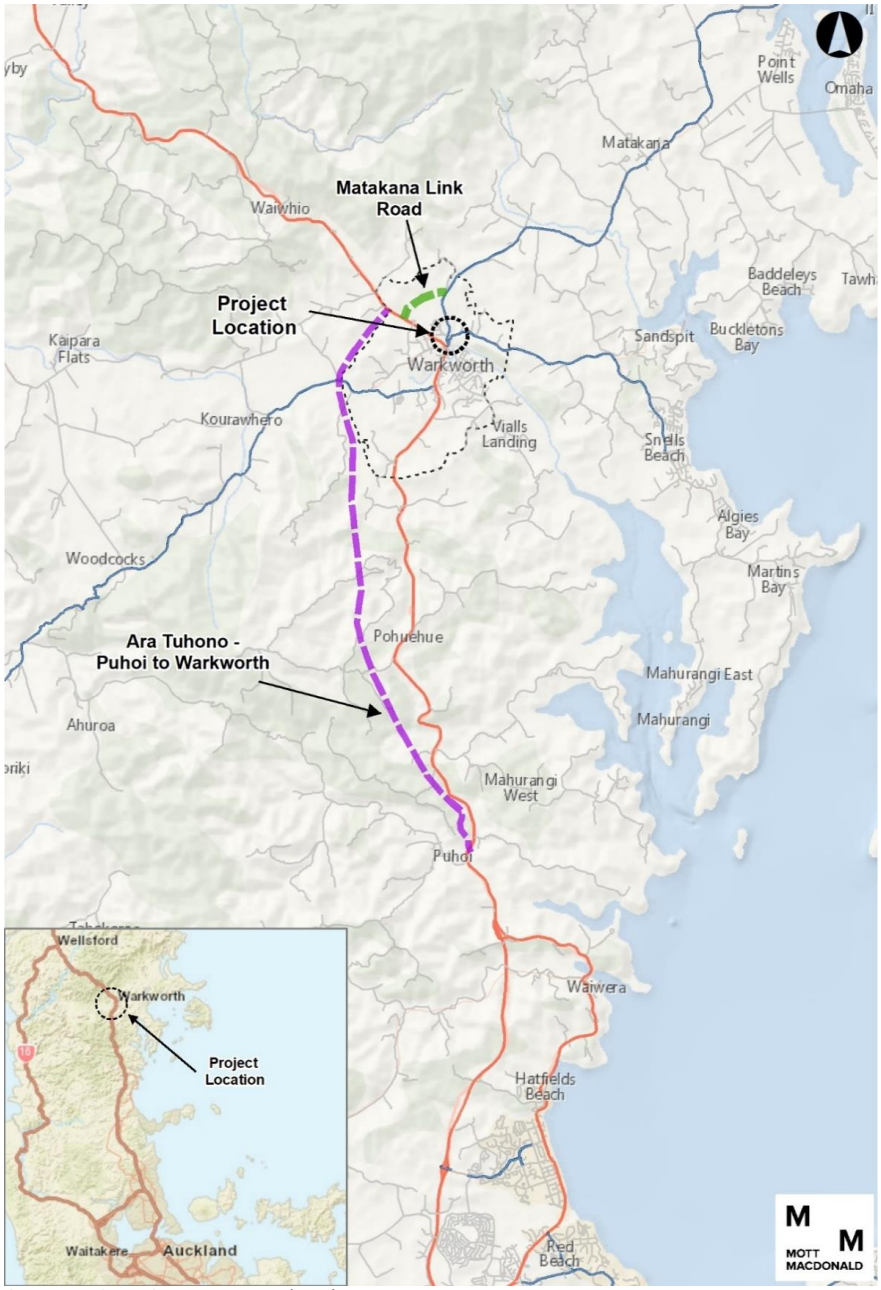
The Hill Street intersection located in Warkworth is approximately 70km north of Auckland's City Centre on State Highway 1 (SH1). It links the Warkworth town centre, Mahurangi Peninsula and surrounding rural communities including Matakana, Sandspit and Kaipara Flats. It also provides access to the eastern beaches such as Omaha, Tawharanui and Leigh and is a key strategic link to the Northland region. The intersection consequently experiences competing travel demands on a daily basis with significant increases in journeys during the summer period and over public holidays.

The population of Warkworth is approximately 5,300[1] residents with 1,700 dwellings, and around 2,250 jobs. The town functions as a service centre for many north Auckland communities, providing retail, education and other essential services.

Figure A displays the location of the intersection in relation to Warkworth and Auckland.

[1] Statistics New Zealand 2018 population estimate

Figure A: Project Location



Source: OpenStreetMap, Esri and HERE

The Hill Street intersection is a compound intersection comprised of multiple intersections in proximity. These include SH1 intersection with Hill Street and Sandspit Road, Sandspit Road intersections with Elizabeth Street, Millstream Place and Matakana Road, as well as access to Kowhai Park (as shown in Figure B).

Figure B: Hill Street Intersection

Source: Auckland Council

Currently, the intersection accommodates both strategic and regional trips as well as local trips between surrounding rural communities, schools, park, town centre and other employment areas. These create conflicts between movements and considerable delays to road users in the morning and evening peak, weekends and public holidays, compounded by the complex layout of the intersection.

Both the P2Wk and MLR are due to be completed in late 2021. The new P2Wk motorway will become a strategic north-south route and its connection with MLR is expected to reduce strategic trips travelling through the Hill Street intersection. MLR will also serve as an alternative route for travellers accessing the eastern coastal townships via Matakana Road, providing resilience to the local transport network.

The completion of these two major transport projects will provide relief to the Hill Street intersection for some time. However, planned growth in Warkworth will generate more local trips, of which a

significant proportion would have no alternative but to travel via the Hill Street Intersection. The level of service for people travelling by foot, bike or public transport in Warkworth is currently low and thus there is a heavy reliance on private vehicle use even for short journeys.

By 2026, traffic volumes are forecast to exceed current capacity at the Hill Street intersection, resulting in significant delays during peak times. Compounded by the current lack of safe and efficient travel choices, these could constrain local growth and result in poor social, economic and environmental outcomes.

Various stakeholders have been engaged to fully understand the problems, opportunities and constraints relating to providing a solution to the Hill Street intersection. Key stakeholders include representatives from across AT, NZTA, AC and Mana Whenua, as well as Rodney Local Board, Member of Parliament, and community groups. A public consultation was also held during the short list options stage which involved community open days and online feedback form.

The following problems were established through an Investment Logic Mapping (ILM) workshop:

- **Problem one:** Operational issues at the Hill Street intersection will restrict the ability of the Warkworth transport network to provide for desired land use and economic outcomes (35%).
- **Problem two:** The inefficient operation of the Hill Street intersection will restrict access to jobs, education, tourism and core services (35%).
- **Problem three:** A lack of safe and effective alternatives to private vehicle travel will reduce the efficiency of the Warkworth transport network (30%).

Addressing these problems would facilitate additional urban growth to be delivered whilst maintaining access to employment and essential services and would make walking, cycling and public transport viable choices

- **Benefit one:** Residential and economic growth (35%).
- **Benefit two:** Accessibility to employment, education, tourism and core services (35%).
- **Benefit three:** Public transport, walking and cycling are viable choices for trips within Warkworth (30%).

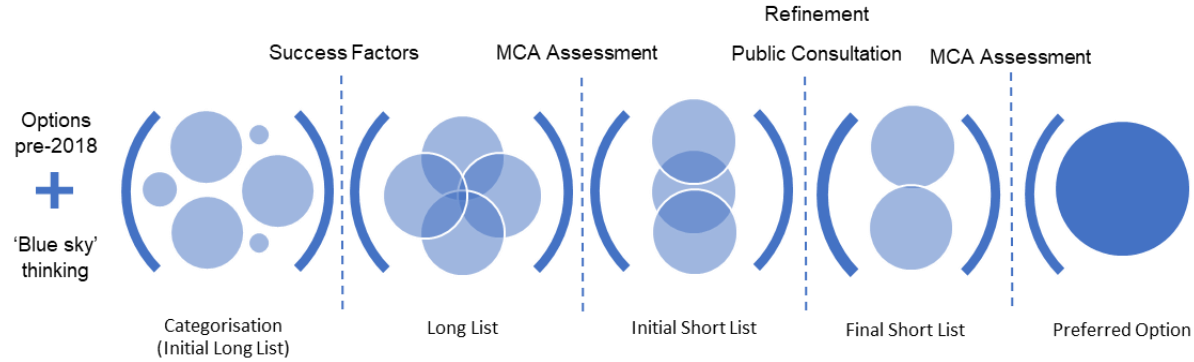
These benefits align closely with the organisational goals of AT and NZTA as well as other relevant planning and transport strategies at the regional and national levels.

This articulation of the full scope of problems at the Hill Street intersection and the anticipated benefits from this investment enabled the investigation to progress to the development of options that can achieve the desired outcomes.

Option Development

An assessment framework was developed with key stakeholders to define how interventions were generated and assessed at each stage of the process (Figure C). Assessments were focussed on the outcomes sought by the proposed investment and specified to a level of detail that would balance robust decision making against appropriate effort.

Figure C: Assessment Framework



Source: Mott MacDonald

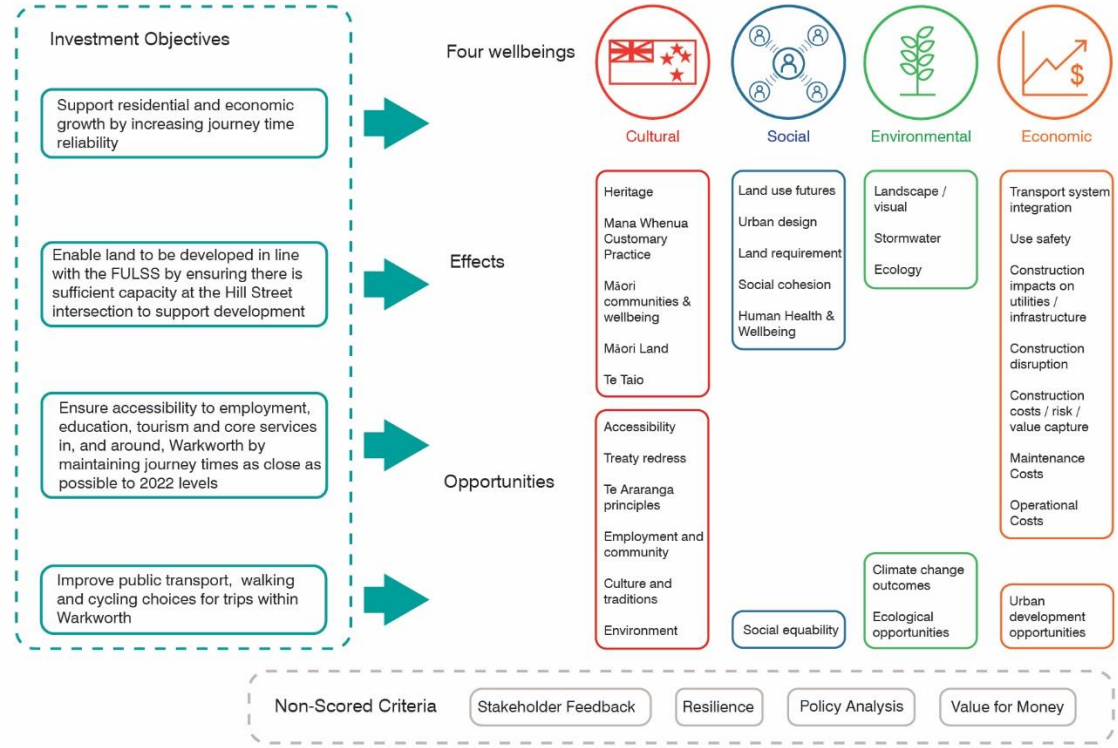
Concept design options developed through previous investigations including ideas from local community groups and individuals were collated. New concept options were also developed through 'blue-sky' optioneering by the project team. In total, there were 30+ options which formed the Initial Long List. These options were then sorted by their key forms and characteristics into 4 categories and 11 sub-categories. These included various forms of gyratory or roundabout, traffic signals, overpasses or grade-separation, removal of one or more intersection link or links, and opening new links away or near the intersection. A representative indicative design was developed for each sub-category and tested against a set of agreed Critical Success Factors (CSFs) with the intention that options without critical flaws in respect of scale, impacts on key local sites or provision for key journeys, would be considered further.

Some designs may perform poorly against at least one CSF; however, all categories were taken forward for further assessment so that more robust evidence and verification can be explored.

The 30+ options in the Initial Long List each have component parts that when separated and combined with that of other options could form 230 new options. Each component was subjected to a stand-alone performance assessment. Components that would not provide an acceptable level of service consistent with the investment objectives were sifted. Components that were considered acceptable were then formed into ten Long List options, representative of all the potential combinations.

The Multi Criteria Analysis (MCA) framework developed by the Supporting Growth Alliance (SGA) was adopted for assessing both the Long and Short List Options, contextualised by the inclusion of the Investment Objectives (Figure D). The assessments of the Hill Street intersection options are therefore deemed consistent with the assessment undertaken for the Supporting Growth indictive transport network for Warkworth. A methodology for applying the MCA framework was the basis for applying scores by relevant subject matter experts and by the challenge team who scrutinised the scores.

Figure D: MCA Framework



Source: Mott MacDonald / SGA

Qualitative ranking of options based on the MCA scores was applied to the Long List. Four of the options were determined to provide far better outcomes than the rest of the options.

The four options were melded into three representative concept designs which formed the Short List Options presented for public consultation. The Short List was refined taking into account new information from the consultation responses, mesoscopic modelling results and details of the emerging preferred Supporting Growth network which was the information available at the time. The refinement produced two design options – one based on a pair of roundabout intersections and one based on a pair of signalised intersections with a new link to SH1 via Falls Street.

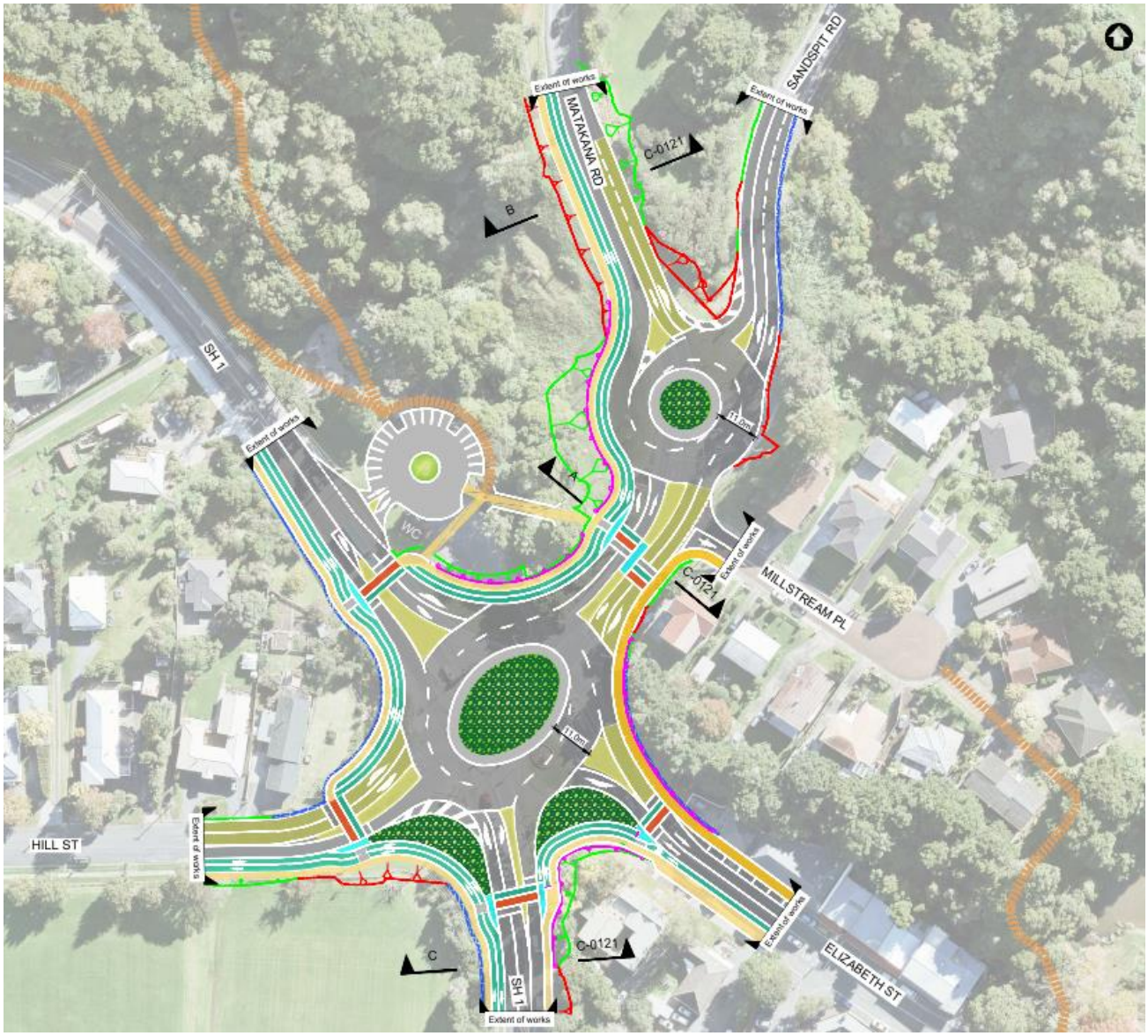
The refined Short List designs were assessed against the adopted MCA framework. The MCA assessment indicated that the two options are closely matched in delivering overall outcomes. An additional analysis was carried out to further ascertain the options' safety outcomes, risks and opportunities, review the estimated costs and assess value for money

The resulting recommendation is to progress with the two-roundabout option as the Recommended Option.

Recommended Option

The Recommended Option concept design is presented in Figure E. The design encompasses two roundabouts, high-quality footpaths, cycle lanes and signalised crossing facilities. It is expected that additional enabling design elements such as retaining structures, cut and fill batters and widening of the existing culvert will be required for construction.

Figure E: Overview of Project Works



Source: Mott MacDonald

The design was further analysed in terms of expected impacts and to identify any implementation issues. The assessment confirms that the Recommended Option will be able to provide capacity to facilitate additional urban growth to be delivered whilst maintaining access to employment and essential services and making walking, cycling and public transport viable transport choices.

Wider project impacts are expected to include reductions in vehicle emissions from enabling other travel mode choices, reducing rat-running and facilitating development of new employment and services locally. Positive social impacts will include enabling improvements to health from increased active travel, as well as better access to facilities and surrounding communities, supporting a stronger local economy. There is potential for some negative outcomes resulting from the increase in the intersection footprint, but it is anticipated that these can be mitigated and that the net impacts will be positive.

Implementation of the Recommended Option will require some additional land to be acquired, however, the actual area of additional land is expected to be reduced during detailed design. Preliminary assessments during this business case have found no critical flaws relating to

constructability, operability, statutory requirements and asset management. This will be investigated more extensively at the detailed design stage.

An economic assessment was undertaken based on methodologies outlined in the Economic Evaluation Manual (EEM). The project delivery costs have been compared against the forecast economic benefits, which are principally travel time savings, but also active travel benefits and reductions in emissions, vehicle operating costs and crashes.

Cost benefit analysis shows the overall benefit cost ratio (BCR) to be 9.1. Further analysis has been undertaken to understand the sensitivity of this value to variations in cost and benefit values, as well as discounting and network assumptions. This analysis shows that overall sensitivity is low for reductions in BCR, but that the proposed delivery of an alternative link between Matakana Road and Sandspit Road could materially reduce the BCR to 3.1. For robustness, a range of **BCR between 9.1 and 3.1** was put forward.

The assessment profile against the latest NZTA Investment Assessment Framework (IAF) was defined. The Recommended Option is considered to have 'High' results alignment due to its importance to agreed land-use and multi-modal transport plans. Consequently, its prioritisation within the IAF is **between 3 and 4** (out of 8).

The capital cost estimate of $18.4 million was reviewed by AT's Commercial Quantity Surveying team and was assessed to be comparable within a 3% margin. The economic assessment was based on an understanding of ongoing maintenance and operations costs, capital estimate and revenue costs.

It is understood that the proposed improvement to the Hill Street intersection will be considered by NZTA for prioritisation in the next National Land Transport Plan (NLTP) 2021-24. The more immediate step is for this business case to be considered by the NZTA Delegations Committee for prioritisation in the next NLTP.

The proposed upgrade will largely affect the existing SH1 and Sandspit Road and partly, small sections of other connecting local roads such as Hill Street, Elizabeth Street, Millstream Place and Matakana Road as well as the Kowhai Park parking access/egress and walking facilities. A special funding assistance rate (FAR) may be negotiated as part of the ongoing revocation process of the existing SH1. AT's share will be sought through the Regional Land Transport Plan (RLTP) review.

Readiness and Assurance

NZTA is currently in consultation with AT on the proposed revocation of the existing state highway status of the section of SH1 between Puhoi to Warkworth which includes the Hill Street intersection. This stretch of road is expected to be vested to AT upon the completion of both P2Wk and MLR in late 2021.

The Commercial and Management Cases are established based on the following:

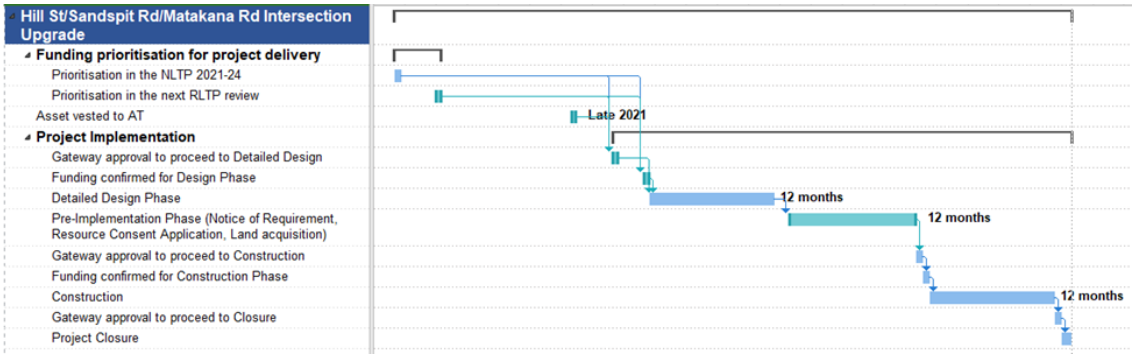
1. NZTA will secure a funding subsidy for the Hill Street Intersection improvement in the National Land Transport Fund (NLTF) prior to vesting of the existing SH1 (Puhoi to Warkworth) to AT;
2. AT will secure local share for the project through the next RLTP review (2021); and
3. **The timing of delivery is post completion of MLR (post-2021).**

The proposed improvement is therefore expected to be delivered by AT who already have a strong long-term relationship with the construction industry in the region with capability to deliver large-scale and complex transportation schemes. AT can also procure and manage services required to deliver the project.

In subsequent stages of this project an implementation strategy will be developed, setting out a proposed approach to consenting, procurement, programme and property.

The key phases and indicative milestones for project implementation are set out in Figure F below.

Figure F: Indicative Project Schedule



Abbreviations

Term	Meaning
AC	Auckland Council
ART	Auckland Regional Transport Model
AT	Auckland Transport
ATAP	Auckland Transport Alignment Project
AUP	Auckland Unitary Pan
BC	Business Case
CAG	Community Advisory Group
CBD	Central Business District
CEP	Communication and Engagement Plan
CSF	Critical Success Factors
DM	Do Minimum
FULSS	Future Urban Land Supply Strategy
GPS	Government Policy Statement
IAF	Investment Assessment Framework
IBC	Indicative Business Case
ILM	Investment Logic Map
ITA	Integrated Transport Assessment
ITP	Auckland Transport Integrated Transport Programme
LOS	Level of Service
MCA	Multi-Criteria Analysis
MLR	Matakana Link Road
NLTP	National Land Transport Plan
NZTA	New Zealand Transport Agency
P2T	Puhoi to Warkworth Strategic Model
P2Wk	Puhoi to Warkworth motorway
PCG	Project Control Group
RASF	Roads and Streets Framework
RLTP	Regional Land Transport Plan
RSA	Road Safety Audit
SAR	Scheme Assessment Report
SEA	Significant Ecological Area
SGA	Supporting Growth Alliance
SGP	Supporting Growth Programme
SH1	State Highway 1
SSBC	Single Stage Business Case
TFUG	Transport for Future Urban Growth
VC	Volume to Capacity

Part A – The Case for the Project

Auckland Transport (AT) and the New Zealand Transport Agency (NZTA) are working together as partners to investigate improvements to the Hill Street intersection in Warkworth to address congestion, issues with reliability and resilience, perceived safety concerns and lack of practical transport choice for travellers.

A number of studies have been carried out in the past to resolve these issues, however, this project differs in that it focuses on the mid-to-long term. Significant changes to the transport and land use context of Warkworth are planned over the next 30 years. This includes Ara Tūhono, Matakana Link Road, and an increase to more than five times the current population, new housing and jobs over the next three decades. The aim is to develop a solution that will reflect these changes.

This Single Stage Business Case:

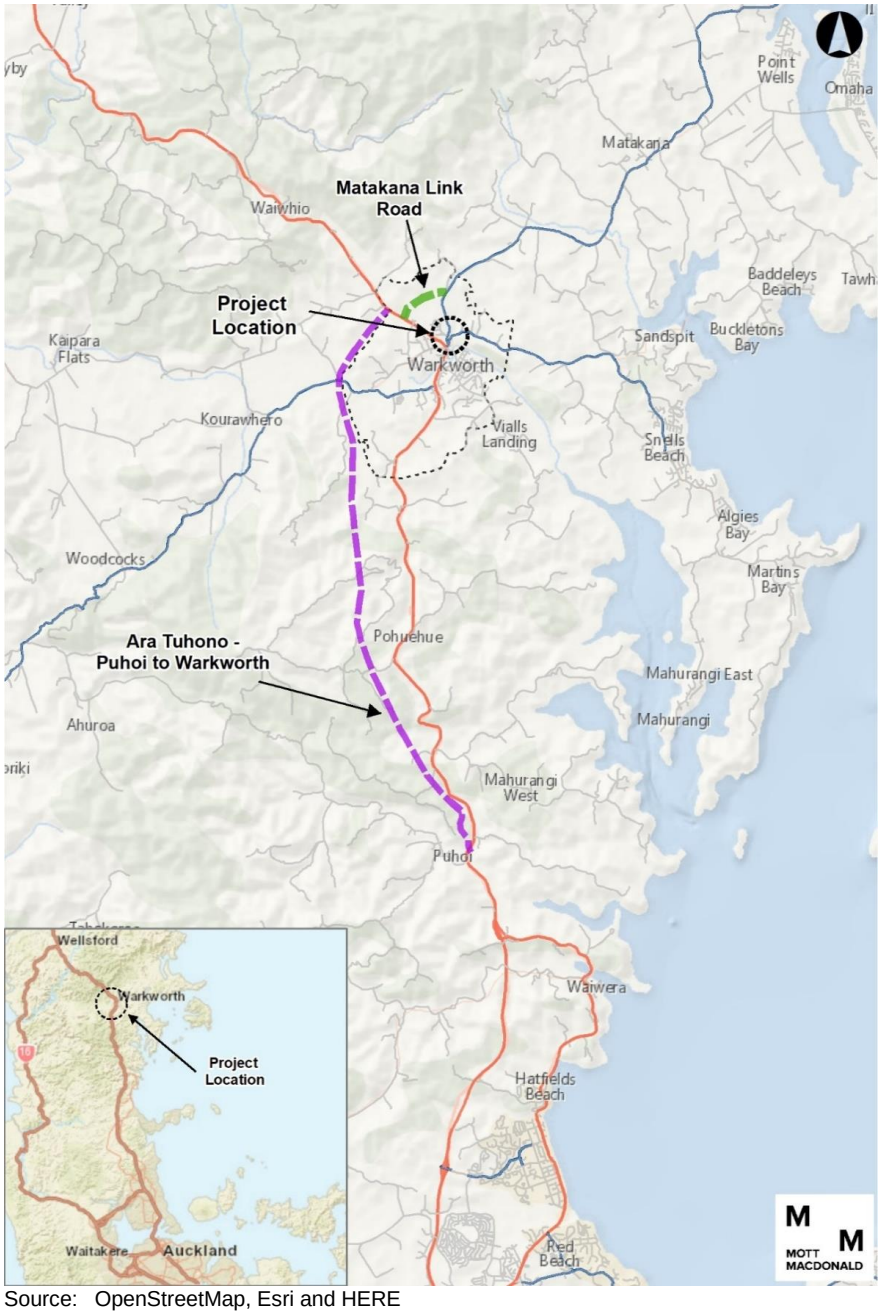
- ensures that the problems and potential benefits are well understood by stakeholders;
- confirms the need for investing in a mid-to-long term solution;
- identifies a Recommended Option for addressing the problems and achieving the desired benefits;
- sets out a detailed analysis of the costs, risks and benefits of the Recommended Option; and
- describes the financial, commercial and management cases for the activity.

1 Introduction

1.1 Background

The Hill Street intersection is located in Warkworth, approximately 70km north of Auckland's CBD on State Highway 1 (SH1). It provides access to Warkworth town centre, the Mahurangi Peninsula, and surrounding communities including Matakana, Snells Beach and Kaipara Flats. It also provides access to eastern beaches such as Omaha and Leigh and is a key strategic link to the Northland Region. The intersection consequently experiences competing travel demands on a daily basis as well as significant increases in journeys during the summer and over holiday periods. Figure 1 displays the location of the intersection in relation to Warkworth and Auckland.

Figure 1: Project Location



Source: OpenStreetMap, Esri and HERE

The Hill Street intersection is generally considered by its users to comprise multiple intersections in close proximity. These include the intersection of Hill Street, SH1 and Sandspit Road, Sandspit Road intersections with Elizabeth Street, Millstream Place and Matakana Road, as well as access to Kowhai Park (as shown in Figure 2). In total, six roads meet at the intersection:

- SH1: a nationally significant road which carries a high volume of traffic, including freight;
- Elizabeth Street: the northern gateway to Warkworth Town Centre;
- Matakana Road: providing access to communities and tourist destinations to the north-east;
- Sandspit Road: providing access to communities and tourist destinations to the east;
- Hill Street: providing access to local residential areas and school; and
- Millstream Place: a local residential street.

Figure 2: Hill Street Intersection

Source: Auckland Council

The intersection has a total of eight arms (including both SH1 northbound and southbound, as well as access to Kowhai Park).

Currently, the intersection provides for both strategic trips and local trips to and from the surrounding communities, schools, park, town centre and employment areas. This creates conflicts between movements, and considerable delays for users in the morning and evening peak, weekends and holiday periods, compounded by a complicated intersection layout.

The local Warkworth community and interest groups have significant concerns about the congestion and have lobbied the Rodney Local Board and the local MP for a solution to address the situation. They also submitted a petition to Parliament in July 2017, leading to national media coverage. The intersection is described by Fix Hill Street Now as "New Zealand's worst intersection."

The Ara Tūhono - Pūhoi to Warkworth (P2W) Road of National Significance and the Matakana Link Road (MLR) are due to be completed in late 2021.

Together, these roads will create a strategic north-south route removing strategic trips from the Hill Street intersection, plus an alternative route for travellers accessing the eastern coastal townships via Matakana Road. However, Warkworth is identified as a growth area in the Auckland Plan and is anticipated to quintuple its population. This is anticipated to increase local journeys in and around Warkworth, with a resulting net increase in congestion at the Hill Street intersection.

1.2 Land-Use Context

The population of Warkworth is approximately 5,300[2] people housed in 1,700 dwellings, there are around 2,250 jobs provided within the town. The main commercial centre is centred on Elizabeth Street and Queen Street, with other commercial areas at Woodcocks Road (light industrial) and The Grange development at the southern extent of the town. The town is a service centre for many north Auckland communities, providing retail (supermarkets), education and medical services.

The Warkworth town centre (Elizabeth Street) and Warkworth Primary School (Hill Street) are accessed directly via the intersection. Kowhai Park, Shoesmith Reserve and large residential areas are also among the immediate land uses currently accessed through the intersection.

Under the Auckland Plan, Warkworth is anticipated to grow to become a substantial satellite town with more than five times the current population, new housing and jobs over the next three decades.

To meet this expected growth, around 1,000 hectares of future urban land has been identified mainly to the north, north east and south of Warkworth. The Future Urban Land Supply Strategy (FULSS) sets out a programme to sequence when future urban areas are made available for development over the next 30 years, as this will help to provide clarity about when future urban land will need to have the infrastructure in place to support development.

This expected growth will add additional pressure to the already congested Hill Street intersection and affect the economic vitality of the area.

1.3 Project History

Many transport studies have been undertaken to consider various options to address the future demands and deficiencies along SH1 within the Warkworth area. These include:

- Warkworth Transport Study Options Analysis (Sinclair Knight Merz, 2006)
- SH1 Warkworth Stage 1 – Scheme Assessment Report (Opus, 2008)
- Hill Street Interim Improvements (NZTA, 2014-15)
- Transport for Future Urban Growth (TFUG) Warkworth – Now renamed Supporting Growth Programme SGP – (Jacobs, AT, NZTA and AC, 2016)

[2] Statistics New Zealand 2018 population estimate

- Hill Street Traffic Improvements / Safety Interim Improvements (Beca & AT, 2016-17)

Local community groups have also identified and developed options to address issues at Hill Street. These options will be reviewed and considered in the Optioneering phase.

The Balanced Response Programme for Warkworth agreed under the Supporting Growth Programme Business Case – formerly known as TFUG - did not identify improvements to the Hill Street Intersection. However, since the release of these transport plans, several priority projects have already progressed, and are moving through the business case and consenting phases. These projects (see **Section 1.4**) have been highlighted in 2018 by the Auckland Transport Alignment Project (ATAP) for priority development this decade, to help support the initial development of the future urban areas and ensure good connections develop between these areas and current urban or employment areas.

The Hill Street Single Stage Business Case is one of these priority projects. The remaining share of projects within the transport plans are now being taken forward by a planning entity, known as a Supporting Growth Alliance (SGA).

1.4 Parallel Projects

1.4.1 Ara Tūhono - Pūhoi to Warkworth

P2Wk is a major roading project between Pūhoi and Warkworth, which is expected to be completed in late 2021. The project is expected to improve the connection between Auckland and Northland and to improve safety on SH1. Other impacts will include changes to traffic volumes and movement patterns in the Warkworth area.

The opening of P2Wk will improve connectivity between Auckland and Warkworth and will reroute strategic trips away from the existing SH1 through Warkworth. This is also expected to change the pattern of demand at the Hill Street intersection by providing a quicker connection between Warkworth and Auckland that routes via the northern arm of the intersection (currently SH1) rather than the southern arm. The intersection was not designed to accommodate this pattern of demand.

1.4.2 Matakana Link Road

The MLR is a proposed road connecting Matakana Road and SH1. It is expected to provide additional resilience to the Warkworth transport network by providing connections that bypass central Warkworth, as well as improve access to new growth areas in north east Warkworth. The project is proceeding on the basis of a staged construction to align with expected traffic growth. Stage 1 will provide capacity for two traffic lanes whilst Stage 2 will provide capacity for four traffic lanes. Construction of Stage 1 of MLR is expected to start in late 2019 subject to land purchase and resolution of appeals and to be completed in late 2021.

The opening of MLR (Stage 1) is expected to result in most traffic between SH1 and north east Warkworth, Matakana, Omaha, Leigh and the eastern beaches rerouting away from the Hill Street intersection.

1.4.3 Warkworth Structure Planning

Auckland is growing rapidly and to accommodate a portion of the region's growth, Warkworth has been identified as a Satellite Town and earmarked to support significant future business and residential development. Around 1,000has of land immediately surrounding Warkworth has been zoned Future Urban. Before any urban development of the Future Urban zone can occur, the land must be structure planned. The Warkworth Structure Plan[3], adopted in June 2019, sets out a pattern of land uses and the supporting infrastructure network for the Future Urban zoned land around

[3] https://www.aucklandcouncil.govt.nz/have-your-say/topics-you-can-have-your-say-on/warkworth-structure-plan/Pages/default.aspx#panelLinks

Warkworth. The SGA is working closely with AC to plan ahead and protect the land needed for the future strategic transport projects that will support this growth.

1.4.4 Supporting Growth Programme

AT, NZTA and AC identified the need to determine the most appropriate transport responses to support the projected growth in the Auckland Region. As a result, in 2015 they formed the Supporting Growth Programme – formerly known as the TFUG Programme – to investigate, plan and deliver the transport networks needed to connect these urban growth areas over the next 30 years.

The Indicative Strategic Transport Network to support growth in Warkworth was released in July 2019 and this is shown in Figure 3 below. The transport network is a 30-year plan for a well-connected system that will deliver great safety, accessibility and liveability outcomes in Warkworth. It includes:

- Investment in public transport services, including new public transport interchanges;
- A walking and cycling network, including the Mahurangi river shared path;
- A south-western area 'link' road connecting to a proposed southern interchange, to provide access to proposed residential and business land in south Warkworth; and
- Improvements to the state highway network, including a proposal for a southern interchange from Ara Tūhono.

Over the next years the programme will be progressing more detailed investigations and being staged route protection processes across future urban zoned areas and transport projects.

Figure 3: Warkworth Indicative Strategic Transport Network

Source: http://www.supportinggrowth.nz/growth-areas/warkworth/

1.5 Project Governance

AT and the NZTA have signed an agreement and have agreed to work together as partners to jointly investigate the potential upgrade of the intersection and to produce a Single Stage Business Case (SSBC). Under the agreement, AT are project managing the SSBC with support and funding from NZTA.

It is anticipated that upon the completion of P2Wk and MLR, state highway status will be revoked for the section of SH1 where the Hill Street Intersection is located and full responsibility for the Intersection will pass to AT.

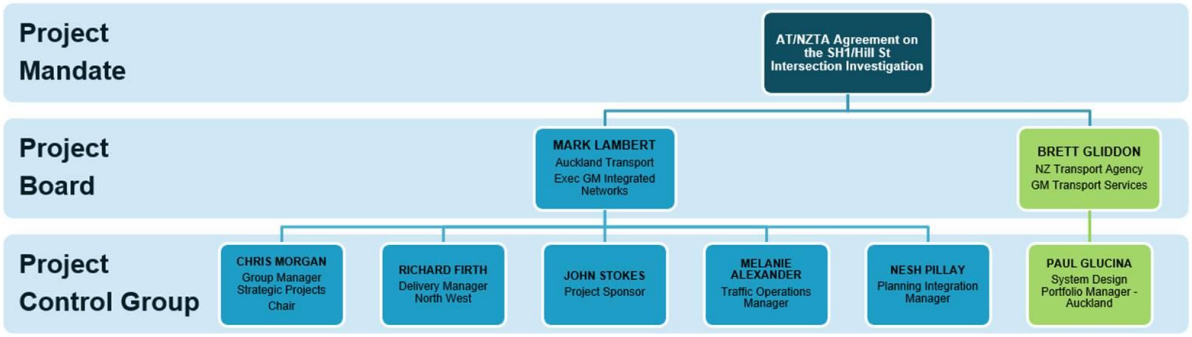
NZTA is responsible for planning, operating and managing the State Highway (SH) network and is an investor in the transport system, including contribution to funding of transport projects, planning policy and programmes undertaken by AT.

AT has responsibility for planning, delivering and operation of transport infrastructure and is an investor in the transport system (apart from the State Highway network) as a CCO (Council Controlled Organisation) of AC.

1.5.1 Organisation Structure

Figure 4 shows the organisation structure set up for the Hill Street Intersection business case development.

Figure 4: Project Organisation Structure



2 Community and Stakeholder Engagement

A Communication and Engagement Plan has been prepared to detail the proposed strategy for liaising with stakeholders for the project during the SSBC.

Regular engagement with stakeholders has been carried out throughout the project, through workshops, community engagement, attendance at hui, meeting with parallel project teams and a public consultation.

This engagement has given stakeholders opportunities to contribute throughout the business case process, from identification of problems and benefits, through optioneering to identification and development of a Recommended Option.

2.1 Consultation and Communication Approach

A Communication and Engagement Plan (CEP) (attached in **Appendix A)** was prepared to detail the proposed strategy for liaising with stakeholders for the project during the SSBC. The CEP identified stakeholders and outlined the objectives and techniques for engaging with these stakeholders.

2.2 Stakeholders

The following groups have been identified as key stakeholders:

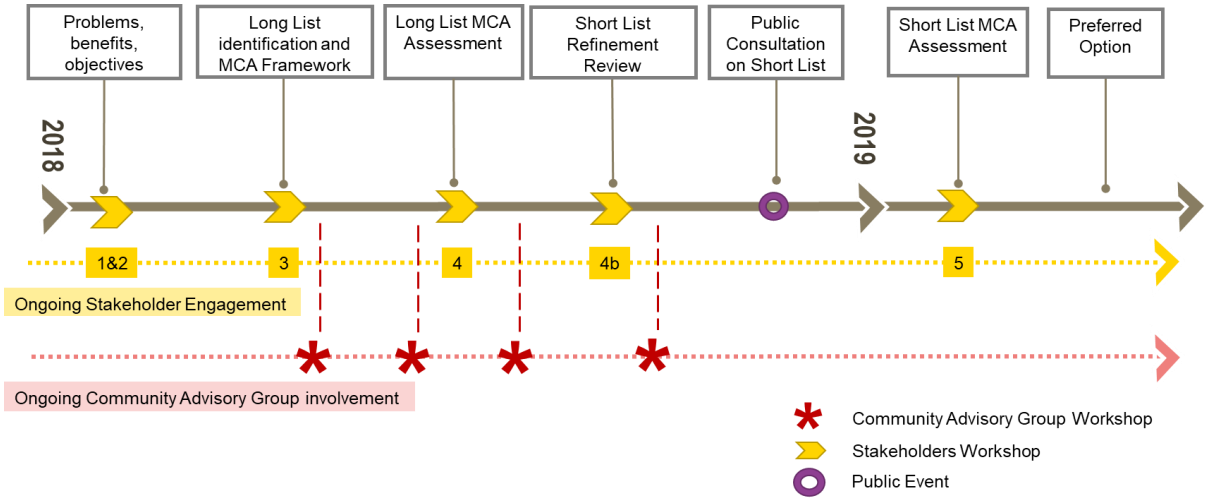
- Project partners (AT, NZTA, Mana Whenua);
- Auckland Council;
- Political representatives;
- Advocacy groups;
- Community and campaign groups; and
- General public.

A full list of stakeholders is provided in the CEP, included in **Appendix A**.

2.3 Engagement Summary

A summary of the community and stakeholder engagement undertaken during the project is shown in Figure 5.

Figure 5: Summary of Engagements



Source: Mott MacDonald

Further detail on the ongoing stakeholder engagement (through workshops), community involvement and public consultation is provided in the following sections.

2.3.1 Stakeholder Workshops

Several workshops with key stakeholders were held as part of the development of the SSBC. Participants included representatives from NZTA, AT, AC and project partners Mana Whenua, covering a range of disciplines.

A list of workshops as well as their purposes and outcomes is included in Table 1 below with further details provided in **Appendix C.**

Table 1: Workshops

Workshop	Date	Purpose	Outcome
Workshop 1 & 2: Problems, Objectives and Benefits Mapping	09/02/2018	• Problem definition • Benefits from investing in the project • Outcomes of the project • Agreed how we are going to measure success	• Refinement of project problem definition and benefits • Refinement of project objectives • Agreement of project scope and future context
Workshop 3: Long List identification and MCA Framework	10/04/2018	• Present the main conclusions from the evidence gathered and analysis undertaken to date • Review the constraints and considerations for the Optioneering Phase • Review and confirm assessment criteria framework (critical success factors and MCA) • Review the Initial Long List and Alternatives • Add additional options to complete a Final Long List	• Agreement on CSFs • Agreement on MCA Framework • Agreement on Initial Long List
Workshop 4: Long List Options Assessment	28/06/2018	• Update stakeholders on project progress and outcomes so far • Review and receive feedback on the final Long List • Review the long list MCA assessment • Discuss the emerging Short List	• Refinement of Short List MCA assessment • Gathering of feedback • Agreement to rule out options

Workshop	Date	Purpose	Outcome
Workshop 5: Short List Assessment	28/03/2019	• Update stakeholders on project progress and outcomes so far • Review and receive feedback on the Short List • Review the short list MCA assessment • Discuss the emerging Recommended Option	• Refinement of Short List MCA assessment • Gathering of feedback

Source: Mott MacDonald

AT members of SGA have provided guidance throughout the project with updates on planned development and feedback received by various stakeholders, including the identification of the transport network and planned development in the Warkworth area.

2.3.2 Community Advisory Group

The project team established a Community Advisory Group (CAG) at the outset of the project to ensure that key representatives from the community were involved in the design development process. Due to the long history of the project and the active local community with a keen interest in the intersection, it was felt that this was an approach which would help build advocacy for the project and mitigate the risks of the preferred option being unsupported by the community.

The CAG is made up of six people, representing the Warkworth Area Liaison Group, One Warkworth Business Association, Mahurangi East Residents Ratepayers Association, Matakana Coast Tourism and the East Rodney Community Group. The chair of the Rodney Local Board and local MP are also members.

2.3.3 Collaborative Working with Parallel Projects

Since the start of the project, the Hill Street project team has been working collaboratively with other projects in the wider Warkworth area. This include:

- Matakana Link Road – the Principal Planner for MLR is also in the Hill Street SSBC project team.
- Supporting Growth Programme – the team working on the Warkworth Indicative Business Case (IBC) are key stakeholders in this business case.
- Auckland Council – Planners working on the Warkworth Structure Plan are key stakeholders in this business case
- Pūhoi to Warkworth / Warkworth to Wellsford project – Communications & Stakeholder Manager also leads the communications and stakeholder management for this project.

2.4 Maori Engagement

A number of Iwi groups who have interest in the project area were engaged during the business case process. Iwi representatives were involved during key stakeholder workshops outlined in Figure 5, as well as sessions at the AT & Mana Whenua Northern Transport Hui. Iwi who have been involved at workshops and/or have attended the hui are as follows:

- Ngāti Manuhiri
- Ngāti Maru
- Ngāti Whanaunga
- Te Kawerau a Maki
- Ngāti Te Ata Waiohua
- Ngāti Wai
- Ngāti Paoa
- Ngāti Whatua o Kaipara
- Ngāi Tai ki Tamaki

- Te Patukirikiri

2.5 Public Consultation

Between 20 November and 14 December 2018, the NZTA led public consultation on the Final Short List designs developed for the Business Case. The consultation programme included a project website, delivery of information letters and factsheets to Warkworth addresses, press releases and two open days at the Warkworth Town Hall on Saturday 24 and Wednesday 28 November.

A total of 376 responses were received, submitted predominantly online, but with a significant minority submitted using the hard copy form. In addition, submissions from three interest groups were received.

The feedback themes identified through this public consultation informed the design refinement and assessment of options to identify a preferred option.

Further details on the common themes identified through the analysis of responses is provided in **Section 6.5** and in **Appendix F.**

3 The Need for Investment

Surveys of existing traffic patterns, alongside transport modelling have confirmed anecdotal reports of issues at the Hill St intersection. Movements at the Intersection are often conflicting and subject to material delays at peak times, resulting in a high level of journey time unreliability.

The completion of committed transport schemes for Warkworth will provide some relief to the Intersection. These projects will reroute strategic trips currently passing directly through the town on SH1, as well as regional and some local trips from Matakana and North East Warkworth.

However, planned growth in Warkworth will generate many more local trips that have no alternative but to travel via the Hill Street Intersection. The level of service for people travelling by foot, bike or public transport in Warkworth is low and creates a reliance on the private vehicle to undertake these journeys.

The result is that by 2026, traffic volumes are forecast to exceed current capacity, resulting in significant delays during peak times. This is compounded by the lack of travel choices for people that will constrain local growth and result in poor social, economic and environmental outcomes.

Addressing these problems provides for the existing community, allows additional urban growth to be delivered whilst maintaining access to employment and core services and making walking, cycling and public transport viable choices.

3.1 Issues, Opportunities and Constraints

3.1.1 Existing issues

3.1.1.1 Transportation Choices

Walking and Cycling

There are currently only limited facilities to walk or travel by bike at the Hill Street Intersection. Figure 6 displays the existing infrastructure for walking and cycling in this part of Warkworth.

Figure 6 shows that currently, the network of footpaths and facilities for walking at Hill Street are limited. There are footpaths along:

- both sides of Elizabeth Street,
- the western side of SH1 south of the intersection,
- the south side of Hill Street; and
- the south-eastern side of Sandspit Road (between Millstream Place and Elizabeth Street).

There is a shared path along the western side of SH1 north of the intersection, which extends to the intersection with Hudson Road.

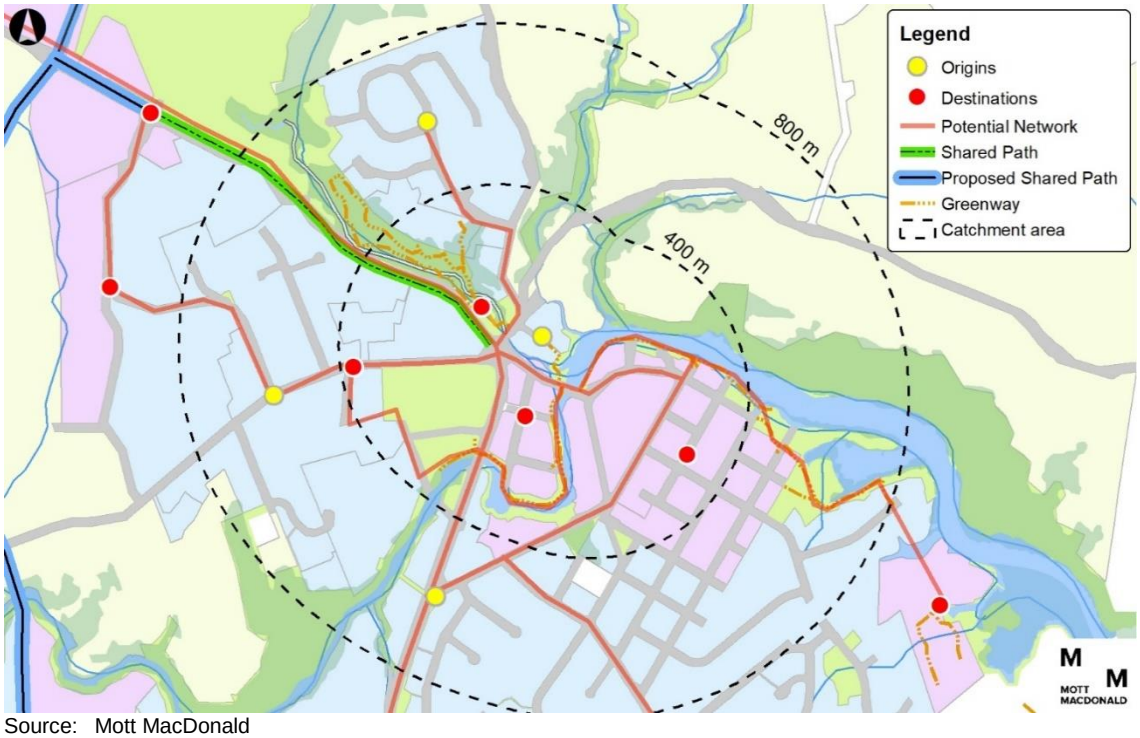
The only formal crossings at the Hill Street Intersection are signalised crossings across the western arm (Hill Street) and the southern arm (SH1). To the south-west these are only linked to the footpaths along Hill Street and SH1 by an informal crossing across the left turn slip lane from the southern arm of SH1. There is an informal crossing across Sandspit Road immediately to the west of the Millstream Place intersection, providing a link to Kowhai Park.

Figure 6: Hill Street Intersection Walking and Cycling Facilities and Desire Lines

Source: Mott MacDonald

Figure 7 displays the local trip origins and attractors for walking or biking trips alongside the proposed routes from the Greenways Plan for Warkworth, developed by the Local Board.

Figure 7: Walking and Cycling Origins and Attractors



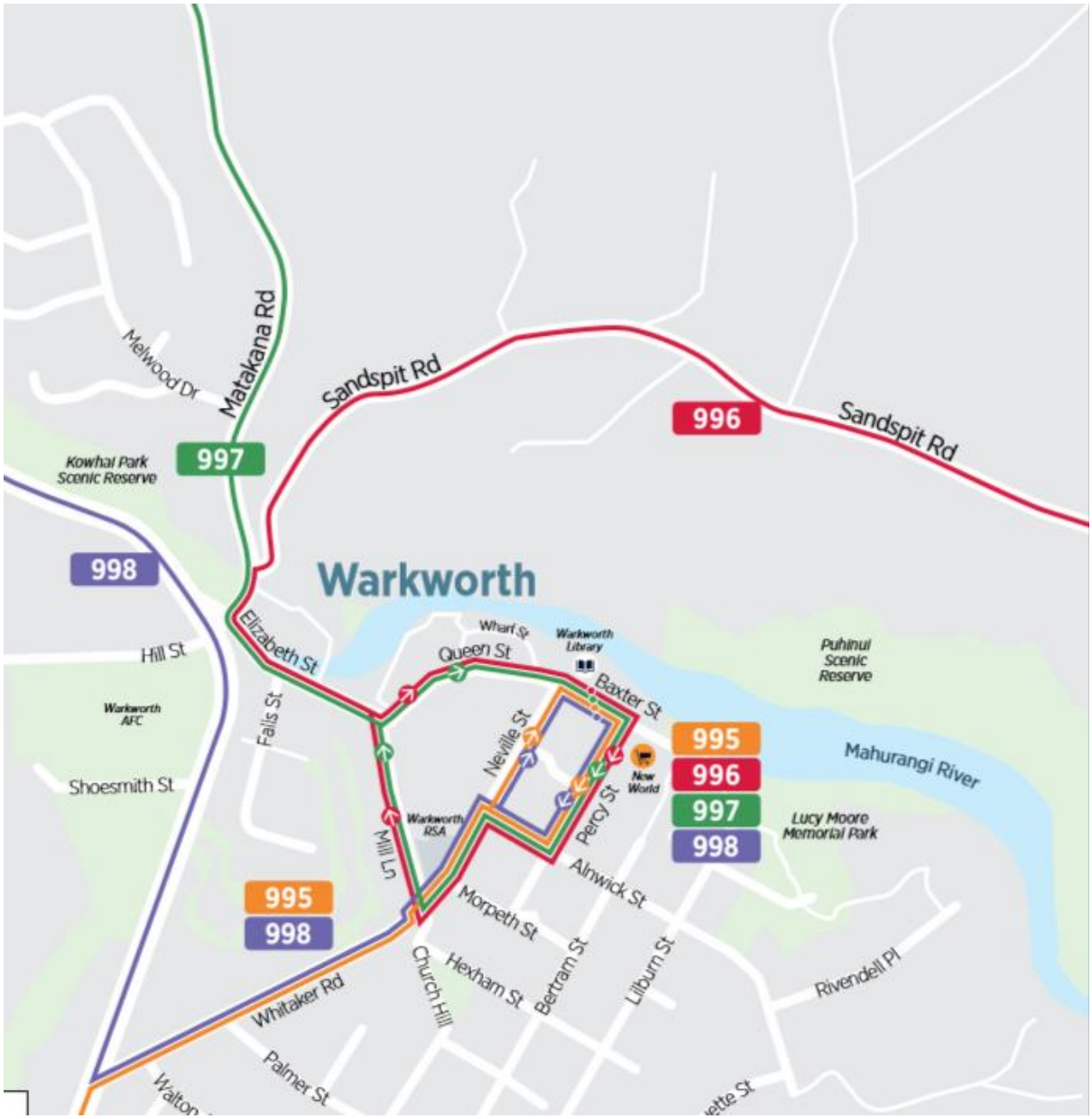
Source: Mott MacDonald

Figure 7 shows that there are a range of origin and destination areas surrounding the Hill Street Intersection. This includes residential areas accessed via Hill Street, Matakana Road, Millstream Place, SH1 and Elizabeth Street, as well as destinations such as Warkworth town centre (Elizabeth Street), Warkworth Primary School (Hill Street) and Kowhai Park (Sandspit Road). The desire lines for walking between these origins and destinations are indicated in Figure 6. The desire lines are either not accommodated by the existing crossings, or else achievable only by use of informal or lengthy crossing routes.

Public Transport

On September 2018, AT launched a new bus network for Warkworth and the Kowhai Coast. With the new changes, there are currently key four regular bus routes in Warkworth, three of which travel through the Hill Street intersection as shown in Figure 8.

Figure 8: Warkworth Bus Services



Source: https://at.govt.nz/media/1979446/nn10_warkworth_feb-2019-web.pdf

- Route 995 provides a link to Hibiscus Coast Bus Station at Silverdale for onward connections to Auckland City Centre, North Shore and Hibiscus Coast, operating every 30 minutes at peak times and hourly at other times
- Route 996 between Warkworth, Snells Beach and Algies Bay, operating eight trips per day on weekdays and four trips per day at weekends;
- Route 997 between Warkworth, Matakana, Point Wells and Omaha, operating seven trips per day on weekdays and four trips per day at weekends; and
- Route 998 between Warkworth and Wellsford operating fourteen trips per day on weekdays and eleven trips per day at weekends.

In addition:

- The Mahu City Express is a private commuter service between Snells Beach, Warkworth and the Auckland City Centre. There are two services in the morning and evening. The Warkworth stop is located outside of the BNZ Bank on Neville Street.

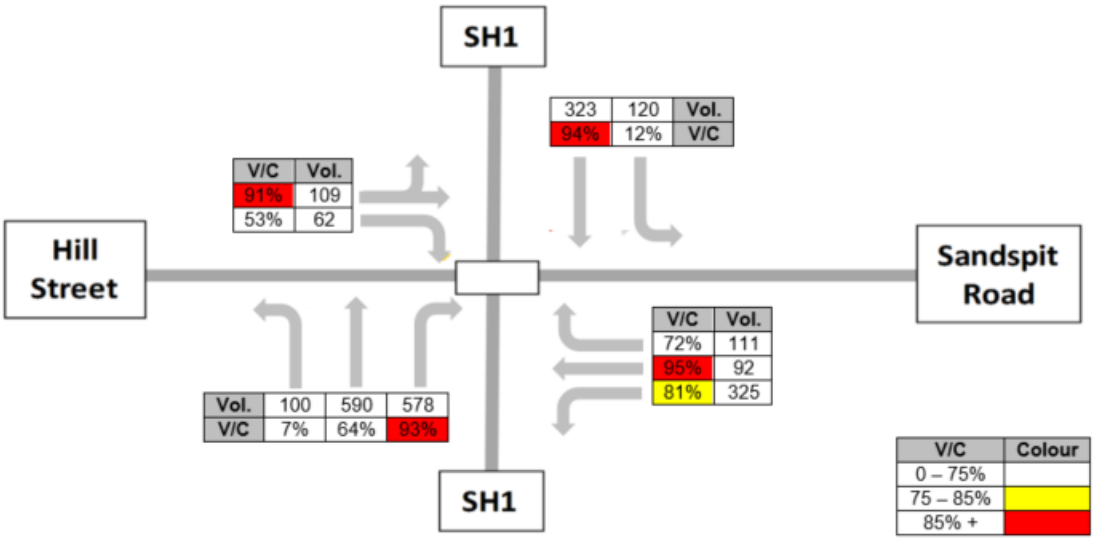
There is currently no public transport priority within the Warkworth transport network and therefore existing services are subject to the same delays and reliability issues as general traffic. Currently, census data reveals public transport use in Warkworth is very low. This is expected to grow with the introduction of the “New Network for Warkworth” described above. The indicative strategic transport network for Warkworth (see **Section 1.4.4**) includes new proposed transport interchanges and new local bus services.

3.1.1.2 Capacity

The capacity of the Hill Street Intersection has been an issue for many years. The *SH1 Warkworth Stage 1: Scheme Assessment Report* 2009 (SAR) identified the Hill Street Intersection as the primary bottleneck as SH1 passes through Warkworth, in both the evening peak and in the Saturday Peak. The SAR identifies local traffic movements as the cause of the bottleneck “with traffic from Elizabeth Street unable to exit via the priority control and the demand to and from Matakana Road and Sandspit Road exceeds the capacity of the current intersection layout”. The *Elizabeth Street Vissim Model Report* 2018 (ESVMR) confirms that capacity remains an issue at the Hill Street Intersection, noting that it “suffers from congestion at peak times of day”.

Analysis of the current operation of the intersection has been conducted using 2016 turning counts. Figure 9 shows that in the evening peak, there are high ratios of volume to capacity (V/C).

Figure 9: Existing PM Peak Capacity Issues at Hill Street Intersection



Source: SIDRA using AT turning counts 2016

Intersection performance is considered to deteriorate where the volume to capacity ratio exceeds 85%. Consequently, the following movements are at, or over, capacity:

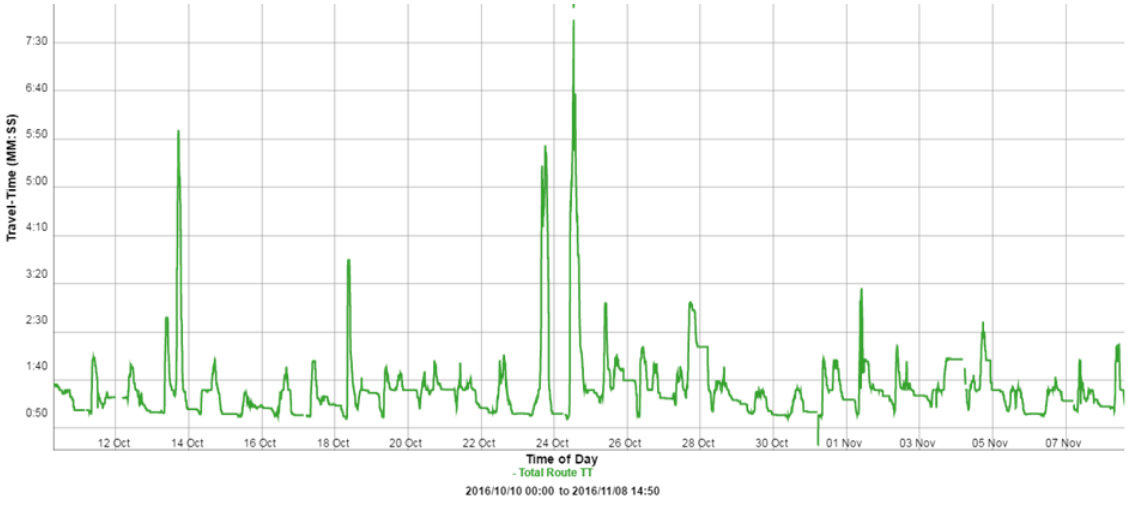
- the right turn from the southern arm of SH1 into Sandspit Road (93%);
- the through movement from Sandspit Road into Hill Street (95%);
- the through movement from the northern arm of SH1 into the southern arm of SH1 (94%); and
- the left turn and through movement from Hill Street into the northern arm of SH1 and Sandspit Road respectively (91%).

3.1.1.3 Delays and Travel Time Reliability

The SAR (2009) notes that queues at the Intersection can block back as far as the Whitaker Road intersection to the south, and the Hudson Road intersection to the north. The ESVMR (2018) confirms that the intersection is still "experiencing delays and queuing in the peak periods and over public holiday periods".

Travel time data for traffic passing through the intersection was collected during October and November 2016[4]. Figure 10 shows there is a high degree of variability in travel times from Matakana Road to SH1 (southbound), varying between one minute (off-peak) to peaks of between two and eight minutes. The longest travel times are associated with weekends (Friday 13 October evening – six minutes, Sunday 23 October evening – six minutes) and public holidays (Labour Day Monday 24 October afternoon – eight minutes).

Figure 10: Wi-Fi Travel Times – Matakana Road to SH1 South of Hill Street



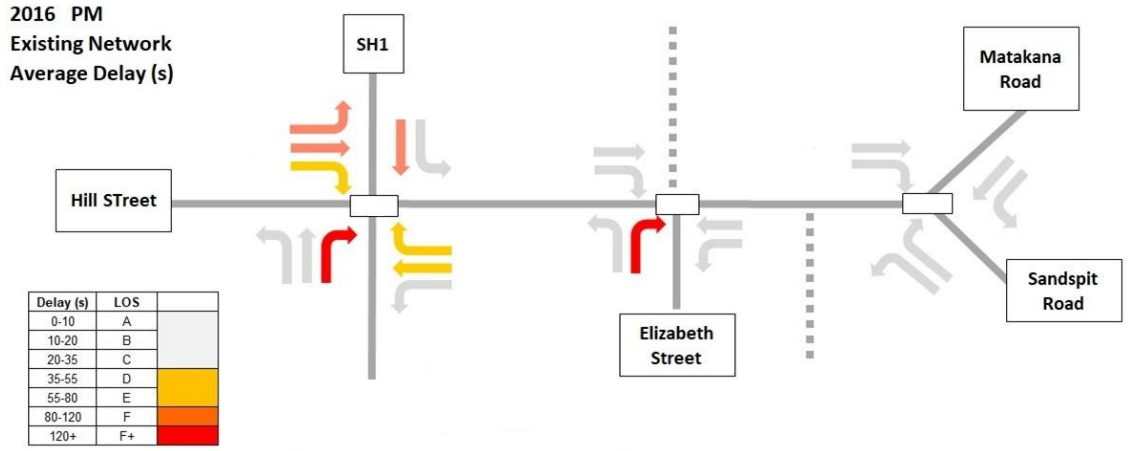
Source: TEAM Traffic

Analysis of delays has been carried out using the P2T Strategic Model[5]. Figure 11 provides a summary of the 2016 delays at the intersection.

[4] Matching vehicles by the unique WiFi signature of enabled devices onboard

[5] SATURN model originally developed for the P2WK study

Figure 11: 2016 PM Peak Delay Issues at Hill Street Intersection - SATURN



Source: P2T Strategic Model (SATURN)

Further analysis of the evening peak delays was undertaken using Vissim model developed for the ESVMR. This confirmed that the average delays turning right from the southern arm of SH1 are high in the evening peak, with a level of service (LoS) rated at F/F+ (over 80s delay).

Both the Vissim and SATURN models show a level of service F+ (over 120s delay) for the right turn from Elizabeth Street and delays for through movements from the northern arm of SH1 (LoS F). The Vissim modelling reveals additional high levels of delay (F/F+) for the left turn from Elizabeth Street and the westbound traffic from Matakana Road, as a result of blocking back from the SH1 intersection.

Overall the modelling shows significant delays for traffic accessing Matakana Road, Sandspit Road and the town centre (Elizabeth Street) on most arms of the intersection, indicating that access to these areas is constrained.

3.1.1.4 Safety

The Hill Street intersection is often perceived to be unsafe by the public. Analysis of crash history at the intersection using the NZTA CAS database shows that there were 31 crashes at the intersection between 2014 and 2018, two of which resulted in minor injuries. The typical level of congestion at the intersection, and complex layout may contribute to lower travel speeds, and therefore lower crash severity. However, the CAS database revealed that one minor crash occurred in 2018 at the main intersection of SH1 with Hill Street when a pedestrian (aged 13) was hit by a truck that failed to stop at the red light. This shows that despite the relatively low occurrence of incidents at the intersection, there are still safety issues for people walking or cycling. As noted in **3.1.1.1** above, formal crossing facilities are only provided at some of the walking and cycling desire lines. Consequently, people trying to cross either Sandspit Road or the northern side of SH1 have no priority over general traffic and are required to take a circuitous route to cross or attempt to cross through traffic. It is likely that the lack of safe, convenient crossings at Hill Street has a significant negative impact on the mode share for active modes.

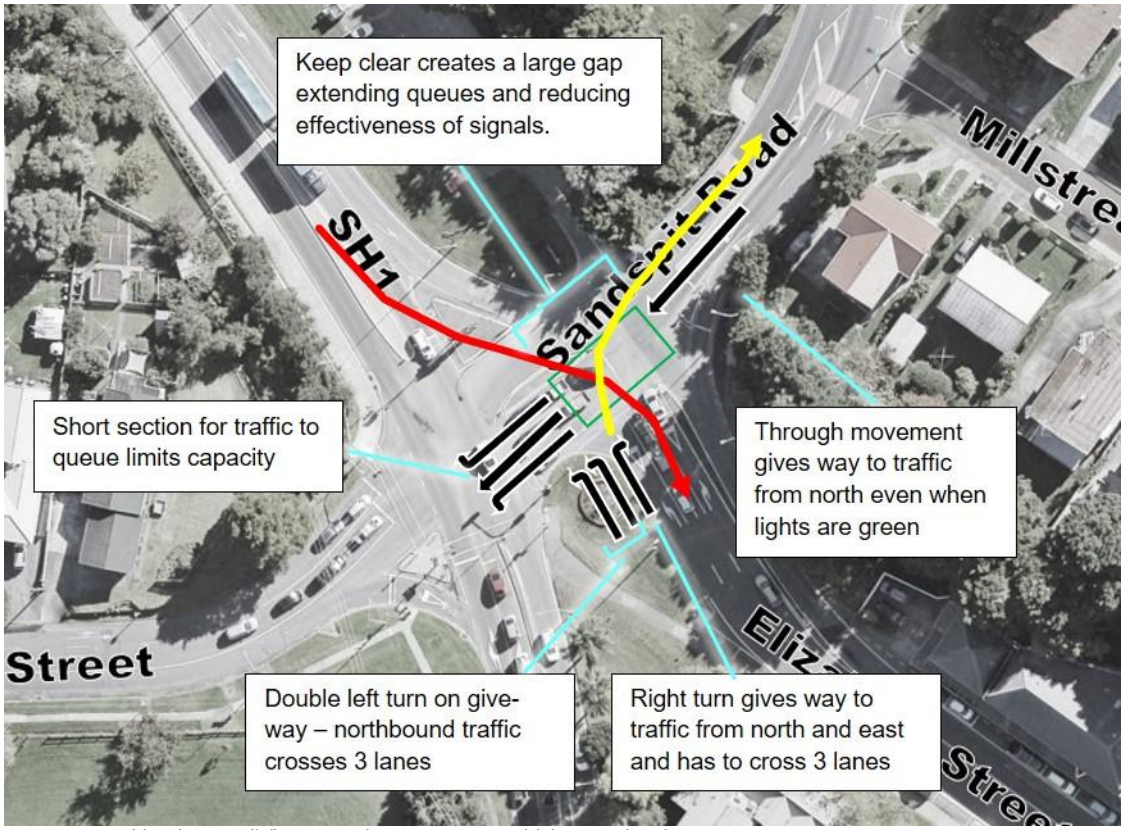
The risk maps available at the NZTA KiwiRAP[6] website show that the collective risk metric[7] of the corridors converging into the intersection have all been assessed as having a low to low medium risk. A number of small improvement projects at the intersection over recent years may have contributed to the low recorded crash history.

[6] https://roadsafetyrisk.co.nz/

[7] Collective Risk is measured as the total number of fatal and serious crashes or estimated deaths and serious injuries within 50 metres of an intersection in a crash period. It is the primary risk metric used for prioritising intersections for road safety countermeasures, as high-risk sites are locations that have the greatest potential for reduction in road trauma.

Figure 12 below shows conflicts at one location within the Intersection. The figure shows how the close proximity of the Elizabeth Street intersection to the SH1 / Hill Street intersection with Sandspit Road results in limited throughput at the latter intersection. This results from the short stacking space available between intersections, exacerbated by crossing traffic from SH1 southbound into Elizabeth Street and traffic seeking to exit from Elizabeth Street to access the SH1 / Hill Street intersection. This is just one of the complex traffic interactions taking place at the Hill Street Intersection. These interactions create safety concerns at the intersection as well as intrinsic capacity constraints.

Figure 12: Illustration of Conflict and Complexity



Source: Auckland Council (base map), Mott MacDonald (annotations)

3.1.2 Development and Growth

Auckland is growing rapidly and to accommodate a portion of the region's growth Warkworth has been identified as a Satellite Town and earmarked to support significant future business and residential development. Around 1,000ha of land immediately surrounding Warkworth has been zoned Future Urban.

The Warkworth Structure Plan, adopted in June 2019, sets out a pattern of land uses and the supporting infrastructure network for the Future Urban zoned land around Warkworth. The plan has been prepared in the context of the existing town of Warkworth and seeks to weave the new development areas back into the fabric of the existing urban area.

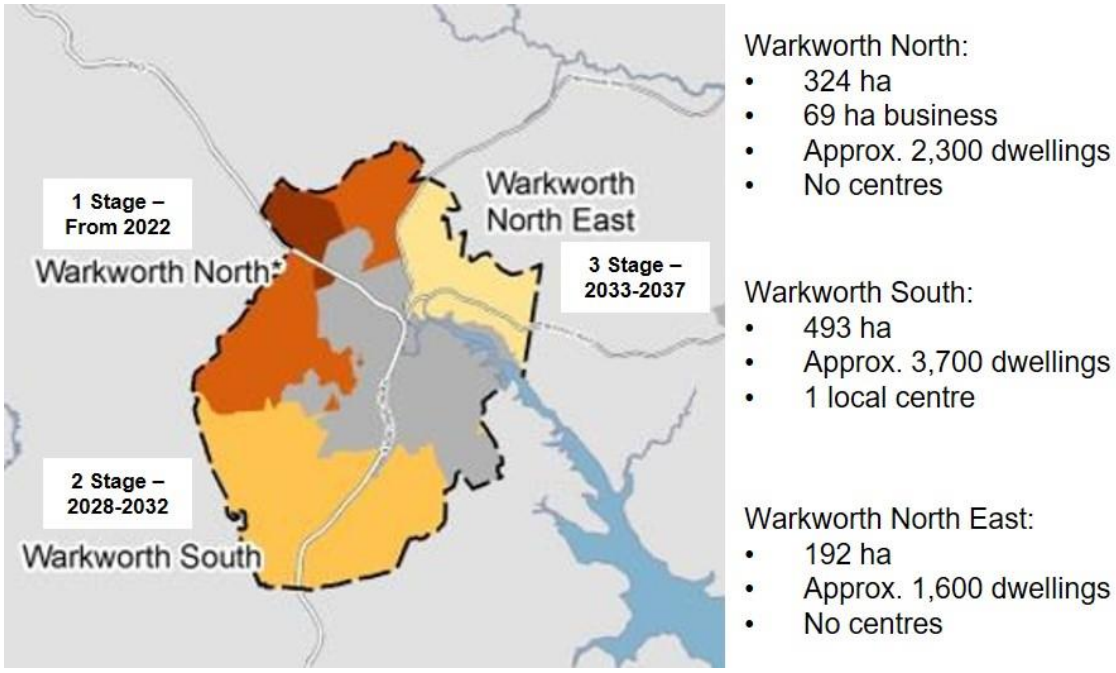
The development of Warkworth's Future Urban zone will occur over the long-term and is sequenced in stages over the next 20 years as bulk infrastructure capacity allows. This structure plan will be implemented through a series of plan changes to rezone the Future Urban zone in accordance with land use indications in the final adopted Warkworth Structure Plan.

Warkworth's Future Urban zone is identified in the Future Urban Land Supply Strategy as being split into three stages that are 'development ready'[8] between 2022 and 2037:

- Warkworth North will be development ready from 2022;
- Warkworth South between 2028-2032; and
- Warkworth North East between 2033-2037.

Figure 13 displays the sequencing of land release for Warkworth. The overall yields in the Warkworth Structure Plan are consistent with the dwelling numbers anticipated in the high-level Future Urban Land Supply Strategy.

Figure 13: Warkworth Land Release Sequencing



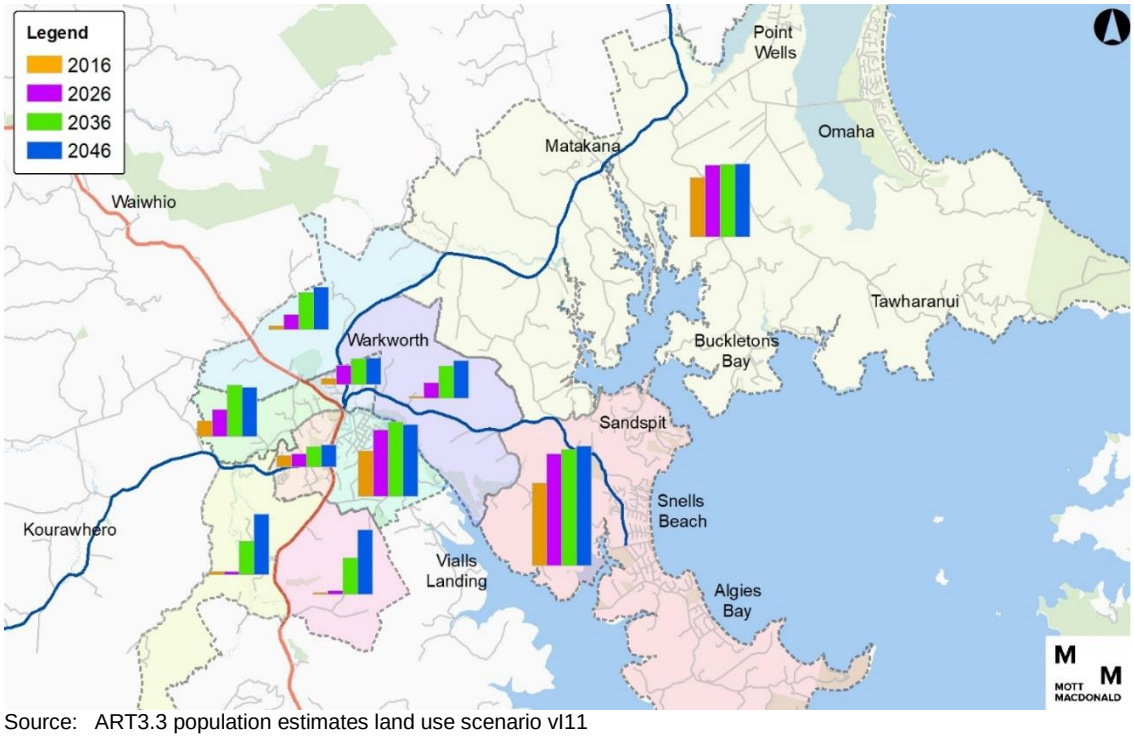
Source: Future Urban Land Supply Strategy and Warkworth Structure Plan, Auckland Council

The development identified within Warkworth will add approximately 7,500 new dwellings and 20,000 more people, which is anticipated to have a proportionate impact on the demand for travel on the Warkworth network, increasing local journeys to access services, facilities and employment. The Hill Street Intersection is therefore expected to experience significant increases in local traffic flows, due to its position as a focus point for local traffic to Warkworth Town Centre.

Figure 14 and Figure 15 show the forecast population and employment growth in Warkworth and surrounding areas through to 2046 from the Auckland Regional Transport Model (ART). There is steady growth in population in most areas over this period, with most of the population growth in Warkworth South not expected until the second stage (2026-2036). New employment will be mostly located in Warkworth South and Warkworth North. Table 2 provides greater detail of the scale of population and employment growth by area and period.

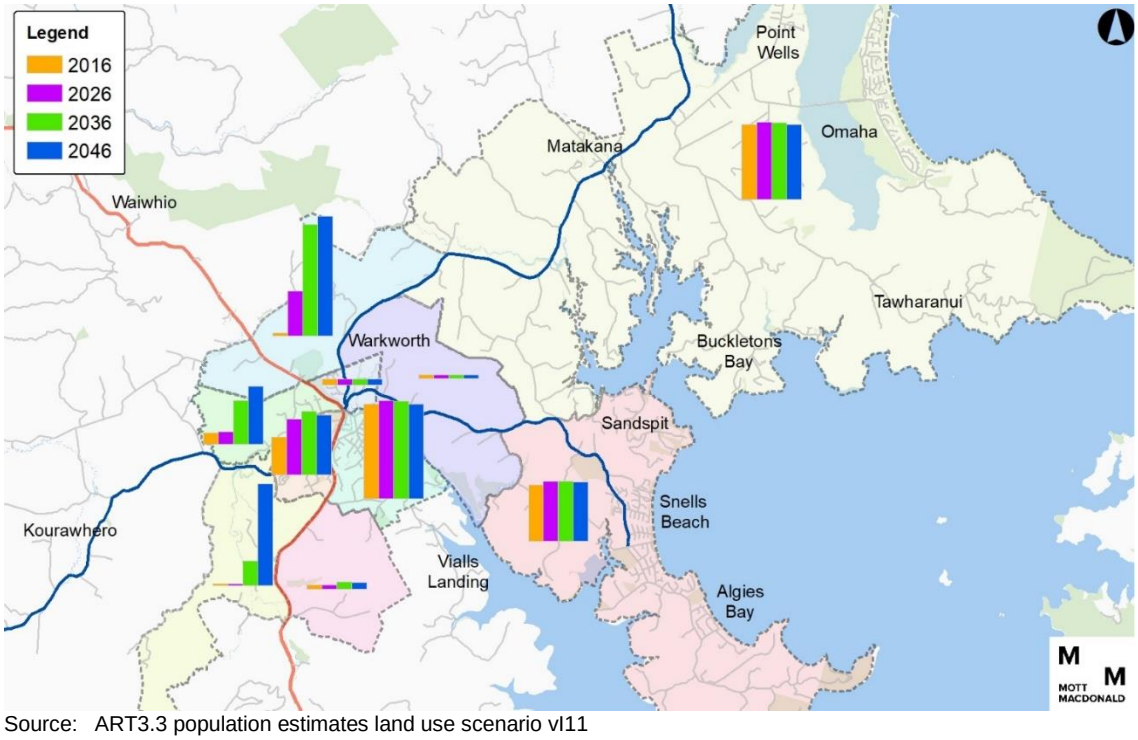
[8] 'Development ready' means that the land has had a structure plan prepared, is zoned for urban uses in the Auckland Unitary Plan, and bulk infrastructure is available.

Figure 14: Warkworth and Surroundings Population Growth by Area



Source: ART3.3 population estimates land use scenario vI11

Figure 15: Warkworth and Surroundings Employment Growth by Area



Source: ART3.3 population estimates land use scenario vI11

Table 2: Population and Employment Estimates

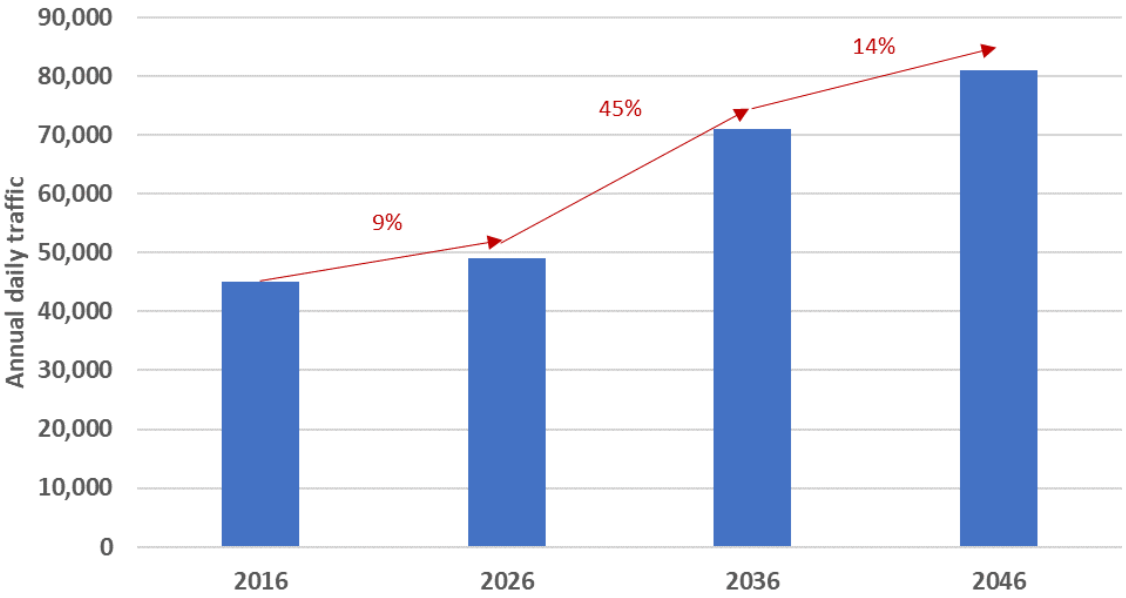
Zone	Population				Jobs			
	2016	2026	2036	2046	2016	2026	2036	2046
Matakana	3,591	4,338	4,382	4,411	1,381	1,429	1,416	1,381

Sandspit/Snells/Algies	4,970	6,717	6,978	7,212	1,047	1,113	1,115	1,099
Warkworth TC	2,729	3,989	4,443	4,323	1,750	1,821	1,805	1,750
Matakana Road	370	1,132	1,556	1,585	106	110	109	106
Hill Street	916	1,631	3,108	2,965	213	227	805	1,072
Matakana Link Road	196	907	2,234	2,547	54	829	2,068	2,220
Woodcocks	695	803	1,237	1,339	695	1,032	1,180	1,111
Sandspit Rd Growth Area	111	922	1,936	2,274	57	59	59	57
Warkworth South East	106	207	2,198	3,916	71	74	134	125
Warkworth South West	184	179	2,024	3,652	40	42	459	1,889
Total	**15,884**	**22,851**	**32,132**	**36,270**	**7,430**	**8,762**	**11,186**	**12,856**

Source: ART3.3 population estimates land use scenario vI11

If only committed transport projects are built, and assuming that there is little change in the modal share for walking, cycling and public transport, the growth is forecast to almost double the total number of daily traffic movements through the intersection by 2046. Under this scenario, traffic volumes will increase from 45,000 in 2016, to 49,000 in 2026, to 71,000 in 2036 and to 81,000 in 2046. This growth is illustrated in Figure 16 below.

Figure 16: Forecast average annual daily traffic travelling through the intersection



Source: P2T Strategic Model (SATURN)

As described in **Section 1.4,** SGA has released an Indicative Transport Network to support this growth in Warkworth**.** This defines, at a high level, networks for active modes, public transport and roading projects that are expected to change the volume and distribution of movements within and through Warkworth.

3.1.3 Transport

3.1.3.1 Short Term

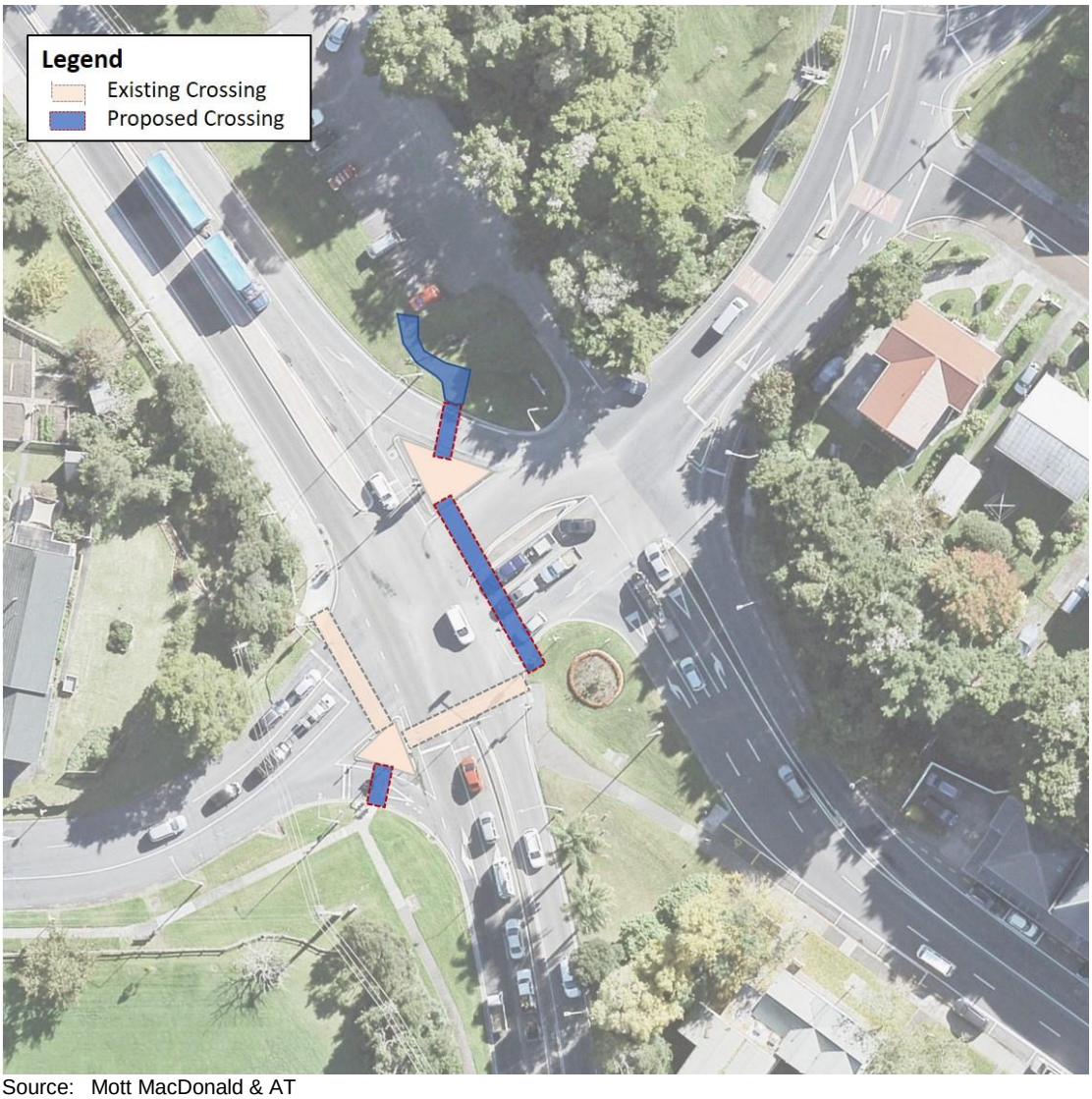
AT, working alongside NZTA, have investigated interim safety improvements for the Hill Street intersection until an agreement for a permanent upgrade of the intersection can be made.

Following a trial of measures between November and December 2016, AT is looking at providing the following improvements as shown in Figure 17:

- A raised zebra crossing on the left slip lanes from SH1 northbound and southbound;
- A signalised crossing on Sandspit Road at the SH1 intersection; and
- Associated footpath links.

Physical works are expected to start in the near future.

Figure 17: Hill Street Intersection – Interim Safety Improvements



Source: Mott MacDonald & AT

3.1.3.2 Medium to Long Term

As described in **Section 1.4** and **Section 3.1.2** the P2W, MLR and SGP projects are expected to change the volume and distribution of movements within and through Warkworth. The SGA has undertaken an Indicative Business Case (IBC) for the transport network in Warkworth. In parallel to this, the alliance has prepared the Warkworth Integrated Transport Assessment in support of the Warkworth Structure Plan. These documents define at a high-level, the following:

- Active mode network;
- Roading network; and
- Public transport network.

The main Information for each network is summarised below.

Walking and cycling

The structure plan seeks to prioritise active transport in Warkworth through a separated walking and cycling network that utilises the arterial road network, collector road network, riparian margins, and other off-road trails to provide connectivity throughout Warkworth. The network provides connectivity to centres, employment areas, schools, parks and public transport stations. Through this network there is the opportunity to significantly increase walking and cycling mode share in Warkworth with the connection distances between most destinations generally less than 5km (in combination with improving e-bike and e-scooter technologies giving the opportunity to travel greater distances by personal transport modes). In addition, a collector road network with separated cycle lanes is proposed to provide further permeability. The active transport network is shown in Figure 18 below.

Roading network

The proposed roading network is shown on Figure 19 and includes:

- Ara Tūhono – Pūhoi to Warkworth;
- Matakana Link Road (Te Honohono ki Tai);
- Western Link Road between SH1 (north) and SH1 (south) including Mansel Drive;
- Sandspit Link Road;
- Wider Western Link Road; and
- Potential Ara Tūhono – Pūhoi to Warkworth southern interchange (with south facing ramps only).

The proposed road network provides both north-south and east-west arterial roads to carry the majority of traffic movements generated by the proposed land use activities within the structure plan area.

The potential Ara Tūhono – Pūhoi to Warkworth southern interchange (south facing ramps only) enables a large proportion of Warkworth, in particular Warkworth south, to travel to and from the south without utilising the existing SH1 route or the utilisation of the internal Warkworth road network to access the Ara Tūhono – Pūhoi to Warkworth roundabout to the north. As part of connecting to the southern interchange, a new Wider Western Link Road is proposed to connect the southern interchange to both the existing SH1 route and Woodcocks Road. This will allow the southern interchange to be accessed by the wider Warkworth area. The interchange is also proposed to be located nearby to proposed industrial land which will shorten travel distances to strategic routes for heavy vehicles and lessen the amount of heavy vehicle traffic on roads within Warkworth.

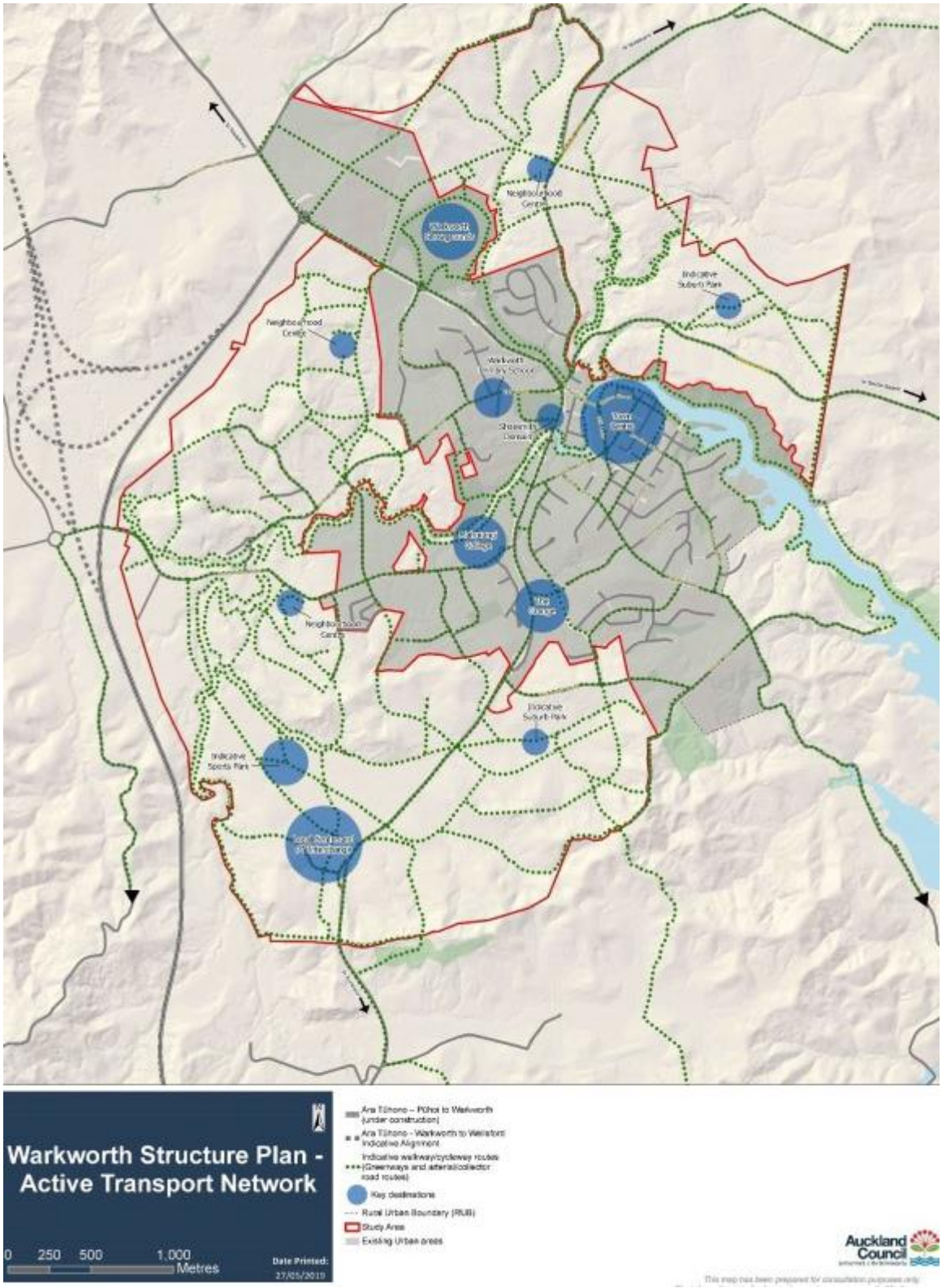
The proposed Sandspit Link Road will enable better vehicle accessibility for vehicles travelling between Sandspit, Snells Beach and Algies Bay, and Ara Tūhono – Pūhoi to Warkworth, by avoiding the need to pass through the SH1/ Hill Street intersection. Essentially, these vehicles can bypass the intersection by following a route along the Sandspit Link Road, Matakana Link Road and SH1 (north of Hudson Road).

As part of the structure plan, Local and Neighbourhood Centres have been located near arterial roads where they can be accessed by private vehicles, public transport, walking and cycling modes.

Public transport network

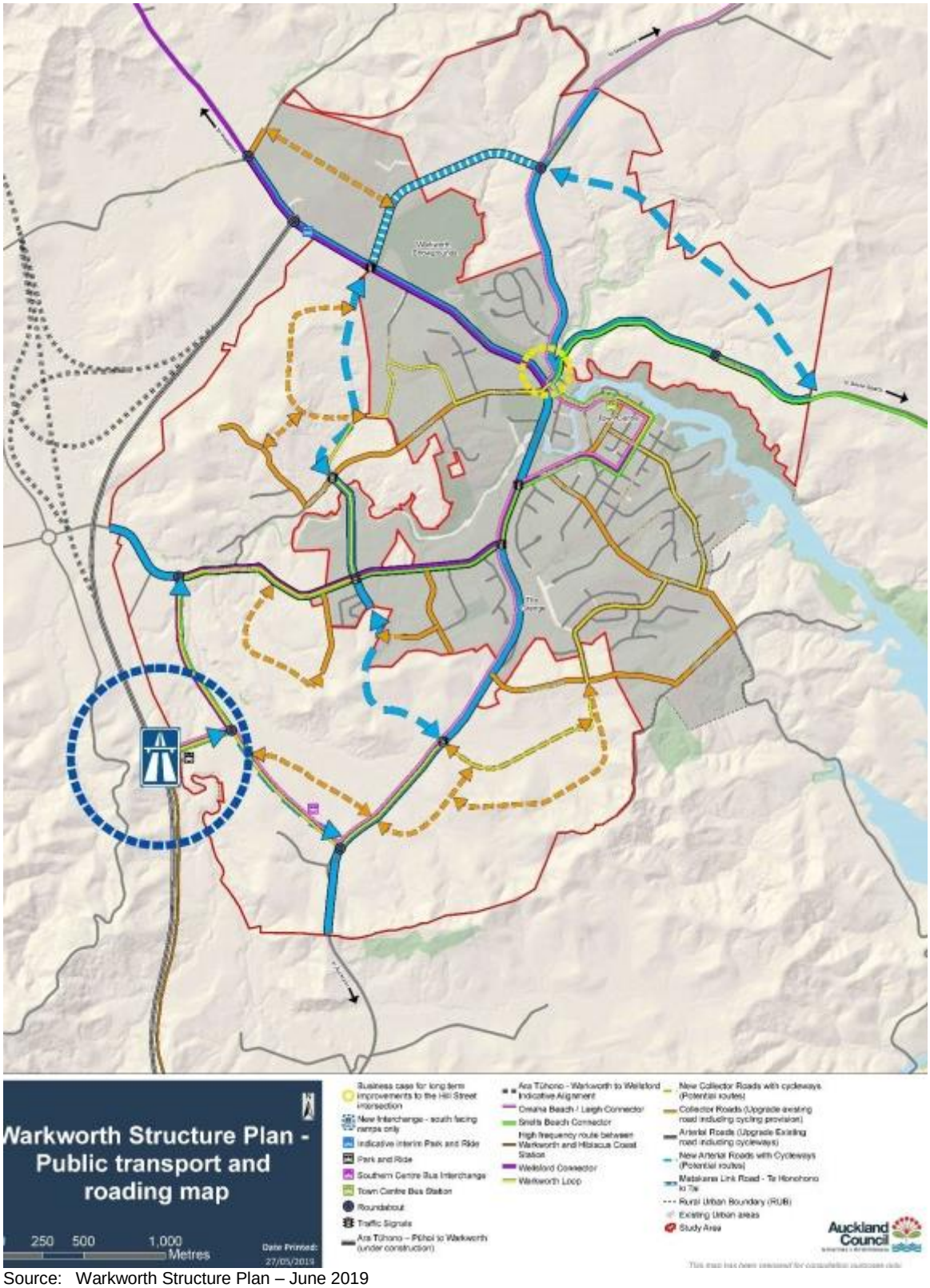
A public transport network that builds upon the recently introduced ‘New Network for Warkworth’ is proposed as shown in Figure 19. Initially, a main station/bus interchange is proposed in the town centre supplemented by an interim northern station adjacent to SH1 north of Warkworth (with a Park and Ride). In the long term, the preference is to retain a Town Centre station but also have a larger bus station/interchange in Warkworth South in the southern Local Centre and a Park and Ride near the Ara Tūhono – Pūhoi to Warkworth southern interchange (south facing ramps only). With a proposed southern station, it is not considered necessary to retain the interim northern station.

Figure 18: Warkworth Structure Plan – Active transport network plan



Source: Warkworth Structure Plan – June 2019

Figure 19: Warkworth Structure Plan – Public transport and roading plan



Source: Warkworth Structure Plan – June 2019

3.1.4 Future issues

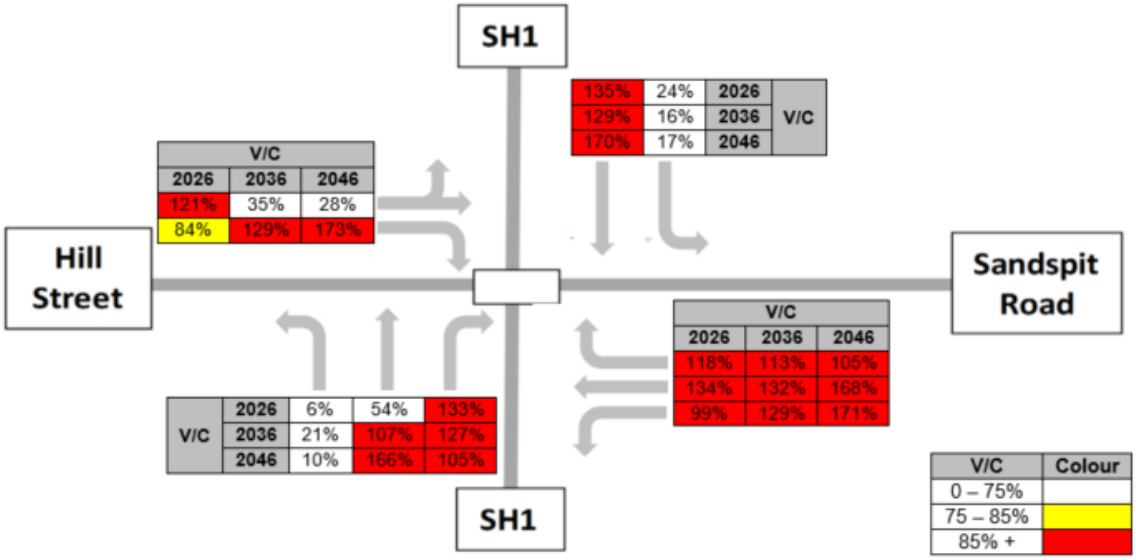
As illustrated in Figure 16 above, the net effect of the committed transport schemes and the planned development in Warkworth will be increased traffic flows at the Hill Street Intersection. As detailed in section **3.1.1** there are existing issues at the Intersection concerning capacity, delays, travel time reliability and access for active modes, so it is anticipated that the forecast growth in traffic demand at the Intersection will result in further deterioration.

Inputs and projects investigated through the SGP were key during the optioneering phase of the project to ensure sensitivities of these schemes were taken into account when developing solutions. However, analysis for this part of the report does not include uncommitted projects to show the worst-case scenario (Do-Minimum).

3.1.4.1 Capacity and Delays

The forecast increase in traffic at the Intersection will become increasingly difficult to accommodate within the capacity of the existing intersection layout. Figure 20 displays the capacity of the intersection for the forecast evening peak flows for 2026, 2036 and 2046

Figure 20: Future PM Peak Capacity Issues at Hill Street Intersection



Source: SIDRA using flows from P2T Strategic Model (SATURN)

Figure 20 shows that PM flow volumes will exceed the 85% of capacity at the Sandspit Road arm, the right turn into Sandspit Road from the southern arm of SH1 and the through movement from the northern arm of SH1 for all future years. The through movement from the southern arm of SH1 will be within capacity in the evening peak in 2026, but will be over capacity by 2036.

Similar analysis has been undertaken to understand delays expected at the intersection. The results show that in 2026 considerable delays are forecast for the right turn from SH1 to Sandspit Road and the right turn from Elizabeth Street into Sandspit Road, with lesser but still material delays for the right turn from Sandspit Road into SH1, the left turn from Hill Street into SH1 and the through movement from Hill Street into Sandspit Road.

These forecast delays, of more than 25 minutes in some cases, will deter people from travelling through the intersection, and show how access to Warkworth is significantly constrained.

3.1.4.2 Access for Sustainable Modes

Walking and Cycling

As Warkworth grows in line with the FULSS and develops into a Satellite Town, it is expected that the demand for active travel will grow as well, particularly the demand for access to the Town Centre and nearby trip attractors such as the Warkworth Primary School and Warkworth Showgrounds. As noted in the adopted Warkworth Structure Plan, the connection distances between residential areas, centres and key attractors, such as employment areas and schools, are generally less than 5km, meaning that walking and cycling trips within the urban area are a feasible transport option for many people.

The Structure Plan active modes network displayed in Figure 18 is centred in the vicinity of the Hill Street Intersection and key nodes in the networks are located nearby, in line with the Intersection's proximity to the Town Centre. The desire lines indicated in Figure 6 are therefore likely to be assigned to growing demand for access by walking or cycling.

Public Transport

The growth of Warkworth and development into a Satellite Town provides the potential for an increase in the provision of public transport services in the town and surrounding area. In addition to recently launched "New Bus Network for Warkworth" which includes three regular bus services travelling through the intersection, the proposed Structured Plan Public Transport Network (see Figure 19) also includes a "Warkworth Loop" service running from Hill Street into Elizabeth Street. With no improvements at the intersection, the delays and the travel time issues described in section **3.1.1.3** will affect public transport services as well, limiting their attractiveness and impacting upon the costs of operation.

Defining the Problem

A facilitated Investment Logic Mapping (ILM) workshop was held on 31 January 2018 with key stakeholders to gain a better understanding of current issues and business needs. The stakeholder panel identified and agreed a set of key problems. The Workshop 1 (Problems and Objectives) and Workshop 2 (Benefits Mapping) memo are included in **Appendix C.**

Subsequently, the final version of the Government Policy Statement 2018/19-2027/28 (GPS) on land transport was released in September 2018. This updated GPS changed the direction of transport policy in New Zealand, shifting the hierarchy of priorities and setting out objectives that are more aspirational than those in the previous GPS, particularly with respect to safety and access. Furthermore, a set of key themes were introduced to guide the interpretation and implementation of the GPS. These themes cover taking a mode-neutral approach, use of technology and innovation, as well as the integration of land use with transport planning and delivery.

The ILM and Investment Objectives for the Hill St Intersection Improvements were reviewed to ensure alignment with the new GPS and some minor amendments were approved. The percentages assigned to each problem statement were adjusted to refocus the ILM towards a more mode neutral approach. The final problem statements are defined as follows:

- **Problem one:** Operational issues at the Hill Street intersection will restrict the ability of the Warkworth transport network to provide for desired land use and economic outcomes (35%).
- **Problem two:** The inefficient operation of the Hill Street intersection will restrict access to jobs, education, tourism and core services (35%).
- **Problem three:** A lack of safe and effective alternatives to private vehicle travel will reduce the efficiency of the Warkworth transport network (30%).

Both the initially agreed ILM and the final ILM are attached in **Appendix B.**

The identified problems are discussed in more detail in the following sections.

3.2.1 Problem One – Restricted Growth

Operational issues at the Hill Street intersection will restrict the ability of the Warkworth transport network to provide for desired land use and economic outcomes (35%).

Supporting growth and integrating transport and land use are the key objectives for the Warkworth transport network as discussed in section **3.1.2.** The FULSS aims to attract investment in housing and employment to Warkworth and to develop the town as a minor centre for economic activity. Consequently, the transport network needs to be able to provide for the movements associated with this planned land use. Following international best practice, these movements are provided for where the V/C ratio is below 85%.

As summarised in section **3.1.1.2**, the Hill Street Intersection is near or at capacity in the evening peak hour. Section **3.1.2** outlines how population and employment growth in Warkworth is expected to lead to growth in travel demand. This growth in demand on the Warkworth network will surpass the ability of the committed transport improvements to provide relief at the Intersection. More detailed analysis in section **3.1.4.1** confirms that the Intersection is forecast to be over capacity by 2026, deteriorating further through to 2046. Consequently, the Intersection will not be able to accommodate the movements associated with the planned growth of Warkworth and will be a major constraint to growth.

Many of the movements to and from Sandspit Road are forecast to be over capacity by 2026, which will constrain access to Warkworth North-East development from Sandspit Road, and to the Warkworth Town Centre and the important services it provides.

3.2.2 Problem Two – Restricted Access

The inefficient operation of the Hill Street intersection will restrict access to jobs, education, tourism and core services (35%).

An efficient intersection will minimise travel time delays for travellers using the intersection as part of their journey. In the context of the Hill St intersection, this applies to trips with no alternative route that support the development and growth of Warkworth.

Warkworth is a service centre for both its immediate residents and surrounding communities including Snells Beach, Wellsford, Sandspit, Matakana, Omaha, Leigh, and Kaipara Flats. The significance of this role is expected to increase in the future as Warkworth develops into the Satellite Town as outlined in the Auckland Plan. Warkworth is also a gateway to the eastern townships and beaches, as well as other tourist attractions to the east and north-east of the town. Tourism plays a key role in the local economy and this is expected to continue as the town develops.

Most of the trips associated with these functions currently must travel through the Hill Street intersection to access town centre services, employment areas or tourist attractions in the wider area. Table 3 provides a broad categorisation and hierarchy of priority for different journeys travelling through the Hill St Intersection.

Table 3: Traveller Classification and Prioritisation

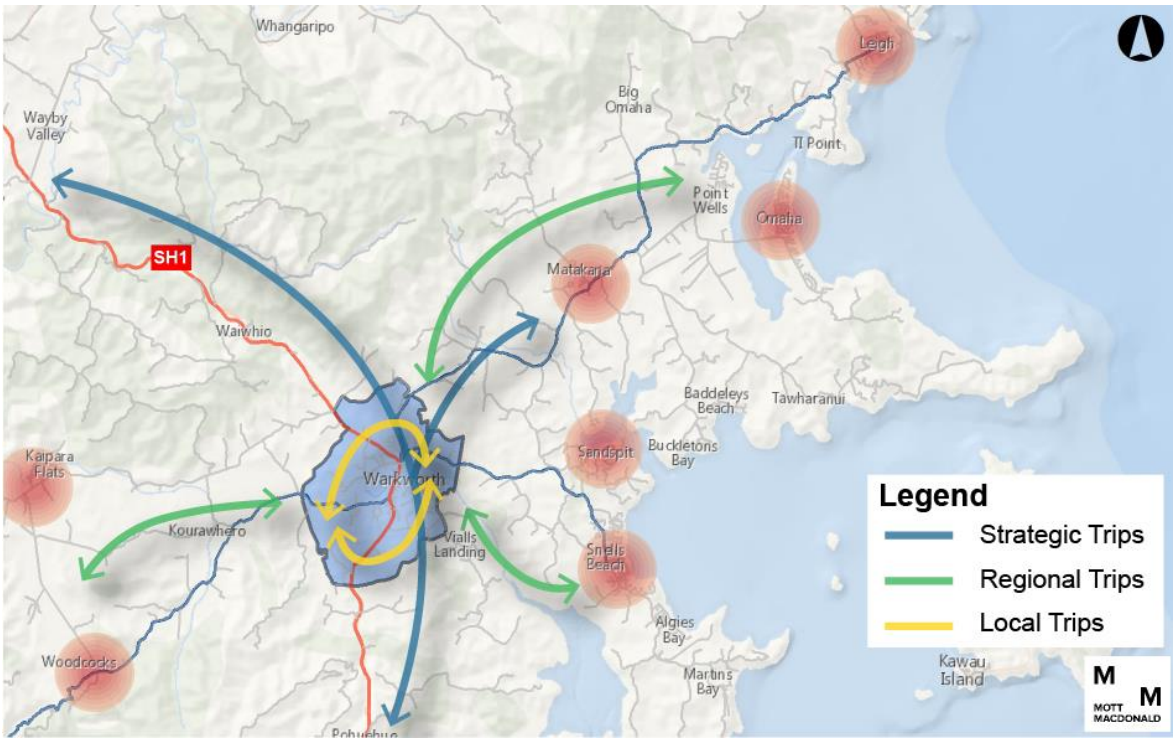
Origin and Destination	Journey Type	Alternative Route	Priority
Starts and finishes within Warkworth	Local	No	High
Starts or finishes within Warkworth	Regional	No	High
Starts and finishes outside Warkworth	Strategic	No	Medium
Starts and finishes within Warkworth	Local	Yes	Medium
Starts or finishes within Warkworth	Regional	Yes	Low
Starts and finishes outside Warkworth	Strategic	Yes	Nil

Table 3 classifies travellers by journey type (local, regional or strategic) and whether they have an alternative route to the Hill Street Intersection (or will have once Ara Tūhono and MLR have been constructed). For example. most strategic trips travelling between locations outside the Warkworth

area will have an alternative route available via Ara Tūhono. Priority has been assigned based on the availability of alternatives and the level of association with the Warkworth area.

Figure 21 displays the journey types in the wider Warkworth area, and Figure 22 shows the location of the core services within Warkworth relative to the Hill Street intersection.

Figure 21: Journey Types



Source: MM & Esri

Figure 22: Warkworth Employment, Education and Core Services

Source: MM

Combining the journey classification outlined in Table 3 with the catchments in and around Warkworth, provides a prioritisation for specific trips as shown in Table 4.

Table 4: Hill Street Intersection Journey Hierarchy

Trips Between	Town Centre	Sandspit	Matakana	Hill Street Catchment	Wider Warkworth
Sandspit	High				
Matakana	High	Low			
Hill Street Catchment	High	High	Low		
Wider Warkworth	Medium	High	Medium	Medium	
Outside Warkworth	Low	Medium	Low	Low	Low

Table 4 shows the main journeys that the intersection should cater for and will form the basis for any design improvements.

Section **3.1.1.3** shows that there are currently material issues with delays and travel time reliability at the Hill Street Intersection. These are expected to deteriorate further and result in a lower level of service as the impacts of trip redistribution onto the new links reduce (section **3.1.4.1**). Movements to and from Sandspit Road and Elizabeth Street are forecast to be subject to major delays during the evening peak hour, worsening significantly from 2036 onwards. Through the journey prioritisation in Table 4, many of these trips are of high priority and delays to travellers will have a highly detrimental impact on efficiency and access to services.

Warkworth is surrounded by many significant tourism attractions, and the delays and lack of travel time reliability experienced when travelling through the intersection may deter visitors, limiting business growth opportunities.

3.2.3 Problem Three – Reduced Travel Choice

A lack of safe and effective alternatives to private vehicle travel will reduce the efficiency of the Warkworth transport network (30%).

Private vehicle is the preferred means for journeys to work for over 90% of people in Warkworth (Census, 2013). Journey to work travel behaviour is typically reflective of the general travel patterns, and in the absence of any other data it has been used to understand the uptake of sustainable modes in Warkworth.

By increasing the mode share of sustainable modes such as walking, cycling and public transport, there is potential to reduce traffic demand on the Warkworth transport network and improve the overall efficiency of the network.

The low existing share for sustainable modes indicates that there is potential for a shift if facilities to make these more attractive are provided. As noted in section **3.1.4.2** the planned growth in the town and environs will increase the potential catchments for these modes

Table 5 provides an overview of the characteristics that make sustainable modes an attractive and feasible option, alongside the typical catchment for these modes.

Table 5: Sustainable Modes

Mode	Characteristics	Customers
Walking	• Direct, attractive routes between origins and attractors; • Good quality grade-separated footpaths / shared paths; • Provision of formal and informal crossing points; and • Security – natural surveillance and lighting.	Residents living within 800m of attractors.
Cycling	• Direct, attractive routes between origins and attractors; • Good quality cycleways / cycle lanes / shared paths; • Minimised gradients and give ways; and • Security – natural surveillance and lighting.	Residents living within 800m – 5km of attractors.
Public Transport	• Safe and effected walking routes to bus stops (see above); • Regular, reliable services; • Good quality waiting facilities at stops, including information and security - natural surveillance and lighting.	Residents living within 400m of potential PT routes.

The existing facilities for walking and cycling (section **3.1.1.1)** do not meet the requirements in Table 5, falling short of the characteristics of safe and effective infrastructure. The SGA is considering plans for improving facilities (section **3.1.3.2**), but as described in sections **3.1.3.1** and **3.1.4.2**, the only committed projects for sustainable modes are minor interim improvements.

3.3 Benefits of investment

The potential benefits of successfully investing to address the problems were identified as part of a facilitated Benefits Mapping workshop held on 31 January 2018. The stakeholder panel identified and agreed potential benefits for the proposal.

These benefits were reviewed following the issue of the final GPS to ensure their alignment and minor changes to their wording and percentage scores were made. The final benefits were agreed as follows:

- **Benefit one:** Residential and economic growth (35%)
- **Benefit two:** Accessibility to employment, education, tourism and core services (35%)
- **Benefit three:** Public transport, walking and cycling are viable choices for trips within Warkworth (30%)

Both the initial and final benefits maps are included in **Appendix B**.

The identified benefits are discussed in more detail in the following sections.

3.3.1 Benefit One – Residential and Economic Growth

Addressing Problem One and solving the forecast operational issues at the Hill Street Intersection, will remove this restriction on the capacity of the Warkworth transport network to provide for desired residential land use and economic outcomes.

The KPIs for this benefit are defined as follows:

- KPI 1.1 – Increased reliability
- KPI 1.2 – Land developed in line with FULSS
- KPI 1.3 – Increased throughput

3.3.2 Benefit Two – Accessibility to employment, education, tourism and core services

Improving the efficiency of the Hill Street Intersection and solving Problem Two will alleviate constraints on access to jobs, education, tourism and core services.

The KPIs for this benefit are defined as follows:

- KPI 2.1 – Access maintained
- KPI 2.2 – Travel times maintained

3.3.3 Benefit Three – Public transport, walking and cycling are viable choices for trips within Warkworth

Enabling safe and effective alternatives to private car travel (walking, cycling and public transport) will improve travel choices within Warkworth and allow those sustainable modes to be viable choices.

The KPIs for this benefit are defined as follows:

- KPI 3.1 – Throughput increased
- KPI 3.2 – Physical health support

3.4 Investment Objectives

In order to ensure realisation of the identified benefits, the following investment objectives have been set:

IO1 **Support residential and economic growth by increasing journey time reliability**

- Supports achievement of Benefits One and Two, indicated by KPIs 1.1, 1.2, 1.3, 2.1 and 2.2.

IO2 **Enable land to be developed in line with the FULSS by ensuring there is sufficient capacity at the Hill Street intersection to support development.**

- Supports achievement of Benefit One, indicated by KPIs 1.1, 1.2 and 1.3.

IO3 **Ensure accessibility to employment, education, tourism and core services in, and around, Warkworth by maintaining journey times for local trips as close as possible to 2022 levels (after construction of Matakana Link Road and with future infrastructure elsewhere responding to growth)**

- Supports achievement of Benefit Two, indicated by KPIs 2.1 and 2.2.

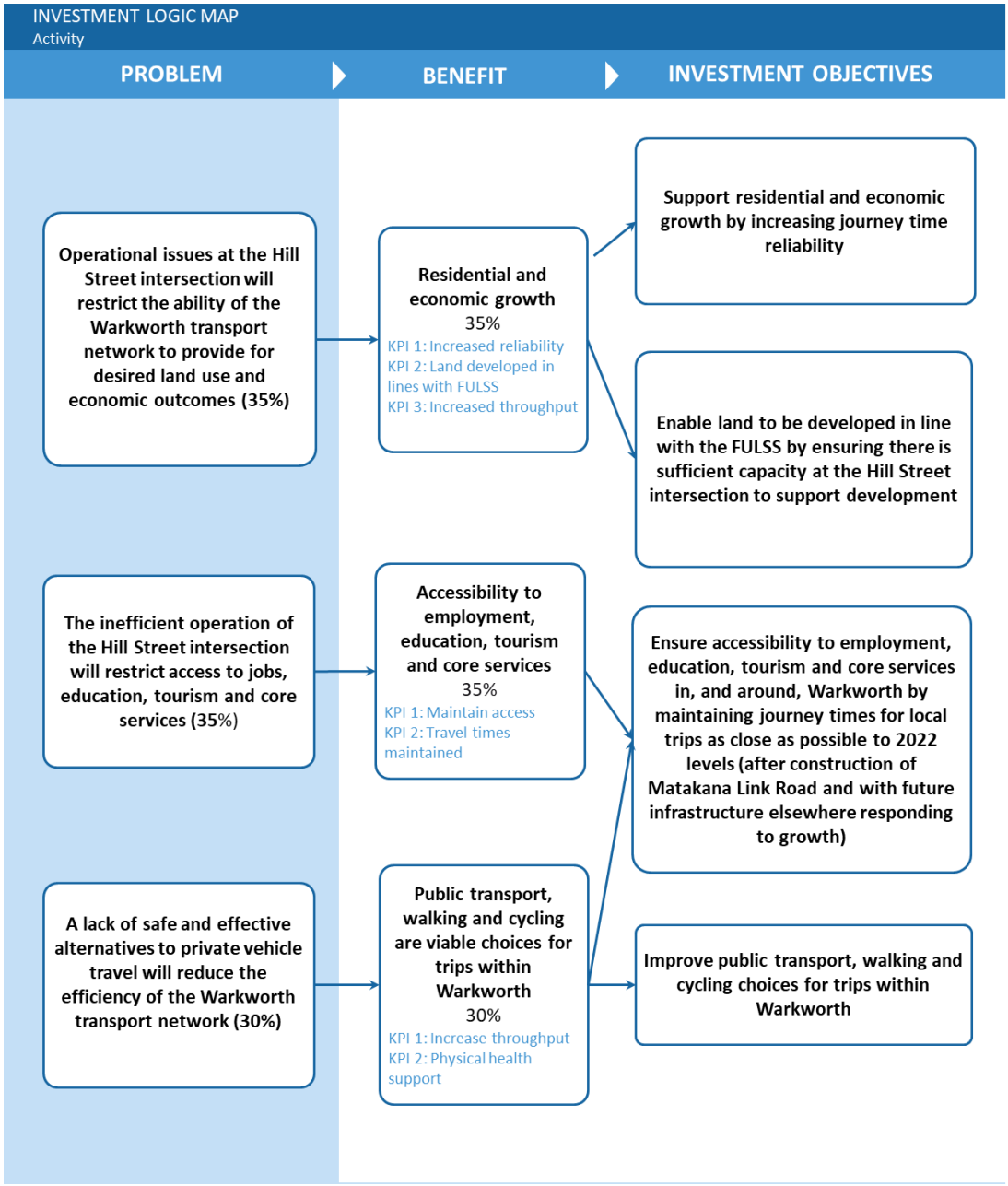
IO4 **Improve public transport, walking and cycling choices for trips within Warkworth**

- Supports achievement of Benefit Three, indicated by KPIs 3.1 and 3.2.

3.5 Investment Logic Map

The full ILM showing the links between problems, benefits and investment objectives is presented in Figure 23.

Figure 23: Complete ILM – Problems, Benefits and Investment Objectives



Source: Mott MacDonald

3.6 Strategic Assessment

AT and NZTA have agreed to work together as partners to investigate the feasibility of upgrading the Hill Street Intersection in Warkworth. Both AT and NZTA have organisational goals that align closely with achievement of the identified benefits for the project. These benefits also align closely with the relevant planning and transport strategies at the regional and national levels.

Several risks to the value of the project have been identified on the supply side and on the demand side, notably the potential for traffic demand to grow at a different rate or to a lesser extent than forecast if development plans change or as a result in changes to policy.

3.6.1 Organisational Overview

3.6.1.1 AT

AT is a council-controlled organisation of Auckland Council. It was established on 1 November 2010 under Section 38 of the Local Government (Auckland Council) Act 2009. Its statutory purpose is "to contribute to an effective, efficient and safe Auckland land transport system in the public interest."

It has responsibility for all of the region's transport system, other than state highway and rail corridors. Among its main tasks are:

- to design, build and maintain Auckland's roads, ferry wharves, cycleways and walkways
- to co-ordinate road safety and community transport initiatives such as school travel
- plan and fund bus, train and ferry services across Auckland.

AT is responsible for developing the Auckland Regional Land Transport Plan (RLTP). The Regional Transport Committee for Auckland (including members from AC has the power to approve the RLTP which must be consistent with the Government's Policy Statement on Land Transport.

AT's Statement of Intent 2019/20 – 2021/22 sets out the following strategic priorities:

1. Help people to travel safety
2. Improve access to frequent and attractive public transport
3. Encourage walking and cycling
4. Make the best use of existing transport networks
5. Support growth, urban redevelopment and regeneration
6. Manage the impacts of the transport system on the environment
7. Ensure value for money

The strategic priorities of improving access to public transport (2) and encourage walking and cycling (3) align closely with Benefit Three. Benefit One tallies with the priority of supporting growth (5). The strategic priority of making the best use of existing transport networks aligns well with Benefit One, Two and Three.

3.6.1.2 NZTA

NZTA's purpose is to create transport solutions for a thriving New Zealand. NZTA's responsibility is to ensure an effective national transport network that integrates the various modes, services and systems to deliver a seamless 'one network' experience for transport users. To achieve this NZTA seeks to integrate one effective and resilient land transport network shaping smart, efficient and responsible transport choices, deliver safe highway solutions and maximise strategic returns on resources invested across New Zealand.

NZTA works with local government partners to deliver the National Land Transport Programme and facilitate a regionally responsive and nationally consistent planning and investment system that ensures that the resources go where they have best effect.

The Land Transport Management Act (LTMA) 2003 requires the NZTA to assess all potential projects against the GPS, the relevant Regional Land Transport Strategy and Connecting New Zealand.

NZTA's Statement of Intent 2018-22 sets out the following position statements:

1. Transport safety – it is unacceptable for anyone to be killed or seriously injured while travelling or working on the land transport system.
2. Inclusive access – everyone should have fair and equitable access to the transport system.
3. Liveable communities – combine planning and investment for transport and land use that result in more vibrant, interactive and communities.

4. Transport technology – combine technology and organisational capabilities to enable safer, sustainable and connected journeys.
5. Resilience – resilience is increased by managing risks and long-term resilience challenges and helping communities quickly recover from disruptions.
6. Environment – manage the land transport system's interaction with people, places and the environment.
7. Regulatory - systems should be intuitive and clear to ensure people, vehicles, and commercial and rail operations are safe, people make good transport choices and harmful behaviour is swiftly dealt with.
8. NZTA is respected by partners, stakeholders and customers for its responsive and engaged people and its timely delivery of sustainable transport solutions.

The focuses on creating liveable communities (3) and increasing resilience (5) align closely with Benefit One, whilst the focus on inclusive access aligns closely with Benefits Two and Three. Benefit Three also aligns with the focus on keeping people safe (1) and creating liveable communities (3).

3.6.2 Alignment to existing strategies

This section provides a summary of the planning and transport policy context related to the Hill Street Intersection. It focusses on relevant planning policies that align with and support the project's objectives, summarised below:

Table 6: Summary of Existing Strategies

Outcomes and Objectives	Alignment with Project Benefits
Auckland Plan 2050	
The Auckland Plan 2050 has been adopted and builds on the first iteration released in 2012. Much of the transport strategy is closely aligned to ATAP. The draft has three directions for transport: 1. Create an integrated transport system connecting people, places, goods and services 2. Increase genuine travel choices for a healthy, vibrant and equitable Auckland 3. Maximise safety and environmental protection	The potential benefits from the project align well with the draft Auckland Plan 2050: • Benefit Two – aligns with connecting people, places, goods and services; and • Benefit Three – aligns with increasing genuine travel choices.
Future Urban Land Supply Strategy (FULSS)	
The FULSS outlines the sequencing of land development in the Future Urban Zones identified in the Auckland Unitary Plan. The objectives of the FULSS is to ensure that appropriate infrastructure is available prior to development, and to provide confidence in forward planning and investment decisions in both the public and private sector.	The potential benefits from the project align with the FULSS: • Benefit One – aligns with the objective to ensure infrastructure is available prior to development.
Auckland Transport Alignment Project (ATAP) (2018)	
The Auckland Transport Alignment Project (ATAP) sets out the way forward for the development of Auckland's transport network. It sets out a shared focus for Government and Auckland Council on delivering economic, social, environmental and cultural benefits to Auckland and New Zealand through providing access to opportunities which is safe, reliable and sustainable. ATAP plans to achieve this by: • Easily connecting people, goods and services to where they need to go; • Providing high quality and affordable travel choices for people of all ages and abilities; • Seeking to eliminate harm to people and the environment; • Supporting and shaping Auckland's growth; and • Creating a prosperous, vibrant and inclusive city.	The potential benefits from the project align well with ATAP: • Benefit One – aligns with supporting growth; • Benefit Two – aligns with connecting people to where they need to go; and • Benefit Three – aligns with providing travel choices.
Auckland Transport Integrated Transport Programme (ITP)	
The ITP sets out the 30-year investment programme to meet the transport priorities outlined in the Auckland Plan. The ITP developed indicators, which are: 1. Better use of transport resources to maximise return on existing assets 2. Auckland's transport system moves people and goods efficiently	The potential benefits from the project align well with ITP: • Benefit One – aligns with supporting growth;

Outcomes and Objectives	Alignment with Project Benefits
3. Increased access to a wider range of transport choices 4. Improved safety of Auckland's transport system 5. Reduced adverse environmental effects from Auckland's transport system 6. Auckland's transport system effectively connects communities and provides for Auckland's compact urban form. Supporting growth is one of the key network challenges identified within the ITP.	• Benefit Two – aligns with efficient movement and connecting communities; and • Benefit Three – aligns with increasing access to a wider range of transport choices and reducing environmental impacts.
Government Policy Statement on Land Transport (GPS) (2018)	
The GPS sets out the priorities for government spending on transport. The GPS is reviewed every three years and covers a 10-year period. The latest revision was in June 2018 and sets the following strategic priorities: • Safety – freedom from death and serious injury; • Access – to social and economic opportunities, choice of access and resilience of access; • Environment - reducing the adverse effects on the climate, local environment and public health; and • Value for money - delivering the right infrastructure and services to the right level at the best cost.	The potential benefits from the project align well with the GPS: • Benefit Two – aligns with Access priority; and • Benefit Three – aligns with Access and Environment priorities.
Regional Land Transport Plan (RLTP) (2018)	
The RLTP sets out the region's land transport objectives and 10-year programme of activities to deliver these objectives. The RLTP identifies key improvements needed to address Auckland's transport challenges over the next 10 years. • Road safety; • Public transport accessibility and mode share; • Walking and cycling mode share; • City centre and Airport access; • Placemaking; • Network capacity and performance; • Developing technology; • Minimise environmental impacts; • Supporting growth; and • Reducing congestion.	The potential benefits from the project align well with the RLTP: • Benefit One – aligns with supporting growth areas; and • Benefit Three – aligns with encouraging walking and cycling.

The alignments with benefits are summarised in Table 7.

Table 7: Strategic Alignment Summary

Strategy	Benefit One	Benefit Two	Benefit Three
AT Statement of Intent	●	●	●
NZTA Statement of Intent	●	●	●
Auckland Plan 2050		●	●
FULSS	●		
ATAP	●	●	●
ITP	●	●	●
GPS		●	●
RLTP	●		●

This review demonstrates a close alignment and given the scale of the issues, potential investment is likely to make a significant contribution to these organisational needs.

3.6.3 Risks

3.6.3.1 Risks of Non-Investment

There are some major risks in not investing to address the identified problems at the Hill Street Intersection:

1. Growth in residential land use and employment in the Warkworth area in line with the FULSS will be difficult to achieve, as the Warkworth transport network is unable to provide capacity to meet the increased demand.
2. Poor access to jobs, education and core services in Warkworth limits economic growth in the town and results in poor social outcomes.
3. Private vehicle becomes the only viable choice for travel in Warkworth, resulting in poor social, health and environmental outcomes.

3.6.3.2 Investment Risks

There are factors of uncertainty that may influence the investment outcomes, detailed in the uncertainty log below.

Table 8: Uncertainty Log

Factor	Timing	Uncertainty	Impact	Comments
Demand Factors				
Rate and timing of growth in residential and employment land use in Warkworth may differ from planned development in response to market/economic forces.	Over FULSS period	Likely	High	FULSS indicates a schedule for development, but numerous factors will influence the sequence and rate of development.
New technology may have disruptive influence, affecting travel demand and patterns	Ongoing from 2026 onwards	Likely	Moderate	Technological change will impact upon travel patterns and demand, but effects in Warkworth expected to be narrower in range than in larger settlements.
Emerging patterns of development may shift demand trends	Up to 2026	Unlikely	Moderate	e.g. planned new hub/centre in South Warkworth may become new town centre and primary access for services and employment. Emerging Structure Plan will allow better understanding of this risk.
Changing policies and legislation and policy setting pace of travel behaviour change	Over political timescales, ongoing.	Probable	High	Central or local government policy, change in travel behaviour through pricing or other demand related regulation.
Supply Factors				
Uncommitted Warkworth transport upgrades	Ongoing	Probable	Low	Development of infrastructure identified in the SGP Warkworth Indicative Network would influence travel patterns and demand at the Intersection, but it is thought would not obviate the need for investment.
Funding availability and timing	Immediate	Possible	High	

Part B – Option Development

4 Assessment Framework

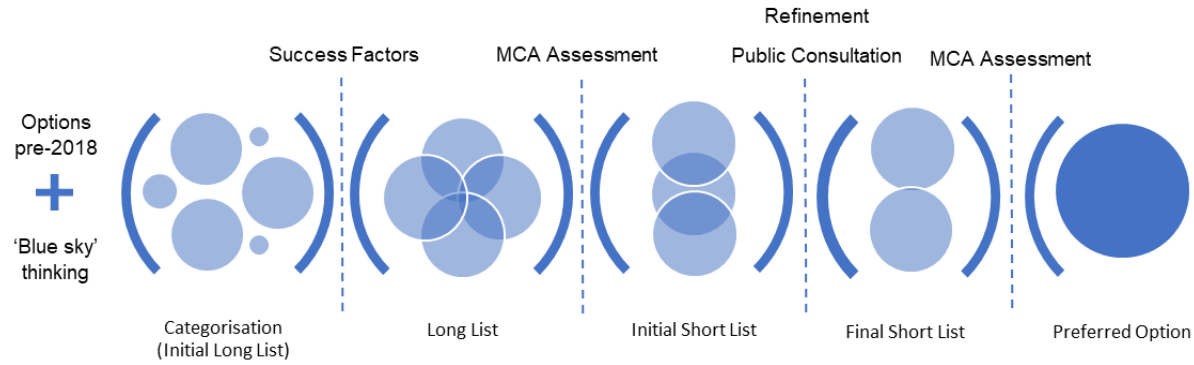
An assessment framework was developed to define how interventions were generated and assessed at each stage of the process. Assessments were focussed on the outcomes sought by the project and specified to a level of detail that would balance robust decision making against appropriate effort.

An initial qualitative assessment of approaches considered at a high level which interventions had potential to contribute to the investment objectives. Following the generation of an Initial Long List, these were sifted by reference to Critical Success Factors. The sift ensured that only options without critical flaws in respect of scale, impacts on key local sites or provision for key journeys, would be considered further.

The Multi Criteria Analysis (MCA) framework developed by SGA was adopted as the basis for assessment of the Long and Short Lists, contextualised by the inclusion of this project's Investment Objectives. This ensured consistency and alignment in the assessment of options for Warkworth by SGA and the Hill Street project. A methodology for applying the MCA framework was developed that would ensure that criteria were assessed by those with appropriate expertise and that stakeholders had the opportunity to challenge the scoring. Robust, stakeholder-approved assessments were the result.

A multi-tiered assessment approach ensures that the assessment of options reflects the outcomes that the project seeks to achieve. This approach allows for evaluation of interventions in a manner that reflects the level of detail available during different project stages. The assessment framework ensures transparency and accountability in decision making, providing a clear line of sight back to the investment objectives and ILM. Figure 24 provides an overview of the four stages of assessment undertaken to identify the preferred option.

Figure 24: Assessment Framework



Source: Mott MacDonald

4.1 Approach Assessment

The approach assessment was a high-level qualitative evaluation undertaken by the project team. This evaluation was a pass / fail assessment on whether the approach had the potential to contribute to the Investment Objectives.

4.2 Critical Success Factors

The project team identified six critical success factors (CSFs) that would provide a 'first sieve' of options. These were discussed and agreed with stakeholders during Workshop 3 (see **Appendix C**). The purpose of this approach is to ensure that options that have obvious and significant constraints or fatal flaws would not be taken forward to a more detailed level of assessment. Table 9 outlines the critical success factors and how they were assessed.

Table 9: Critical Success Factors

Critical Success Factor	Assessment Method
Impacts on heritage assets	Constraints mapping (Unitary Plan layers)
Impacts on notable trees	
Impacts on Significant Ecological Areas	
Impacts on sites of significance to Mana Whenua	Engagement with Mana Whenua
Scale of solution is appropriate to Warkworth's role as a Satellite Centre	Roads and Streets Framework
Provides for key journeys (including active modes)	Operational assessment

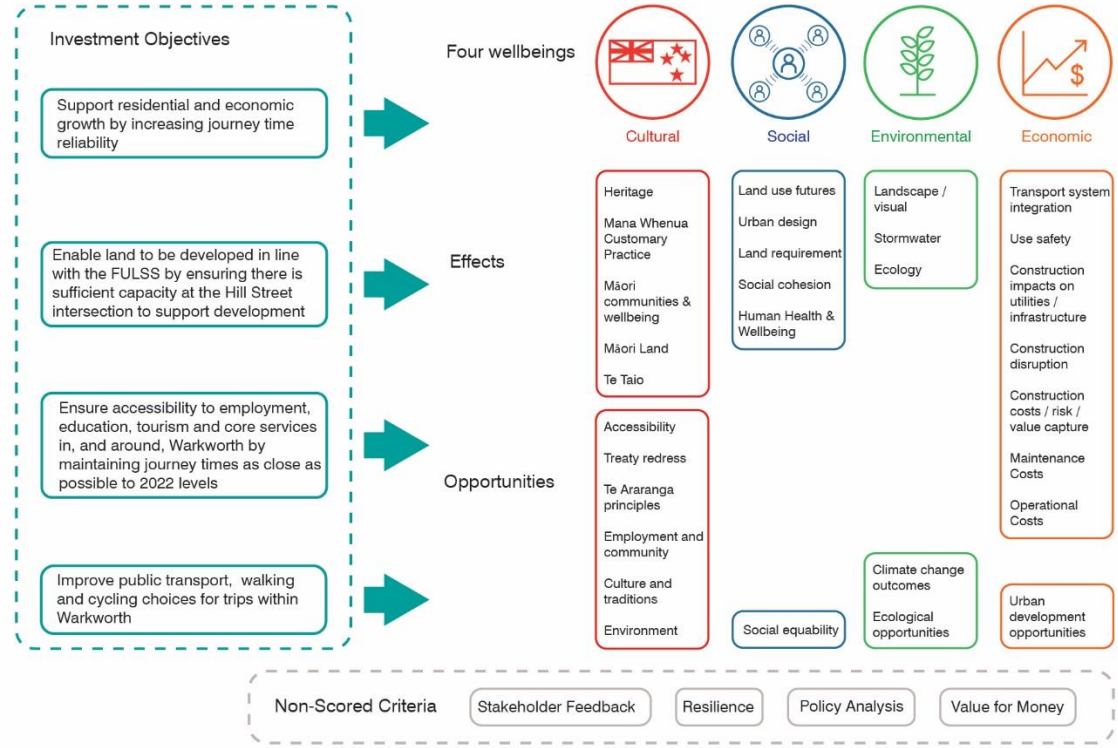
4.3 Multi Criteria Analysis

The SGA has developed a Multi Criteria Analysis (MCA) Framework to provide a consistent approach to the assessment of options. This framework is reflective of the guidance developed by the NZTA in 2017 but differs from the standard MCA framework within the *Multi Criteria Analysis for Transport Business Cases Guidance Document.*

The SGA investigations are occurring concurrently to the Hill Street business case, and there is a high degree of interdependence between the solutions being developed. Consequently, the SGA MCA framework was used for the Hill Street business case to ensure that there is consistency and alignment in the assessment of options for Warkworth.

The MCA framework is based around the investment objectives developed through the ILM process, and the four 'well-beings' of sustainable development. The framework includes non-scored criteria that were analysed separately. Figure 25 provides an overview of the MCA framework and criteria.

Figure 25: MCA Framework

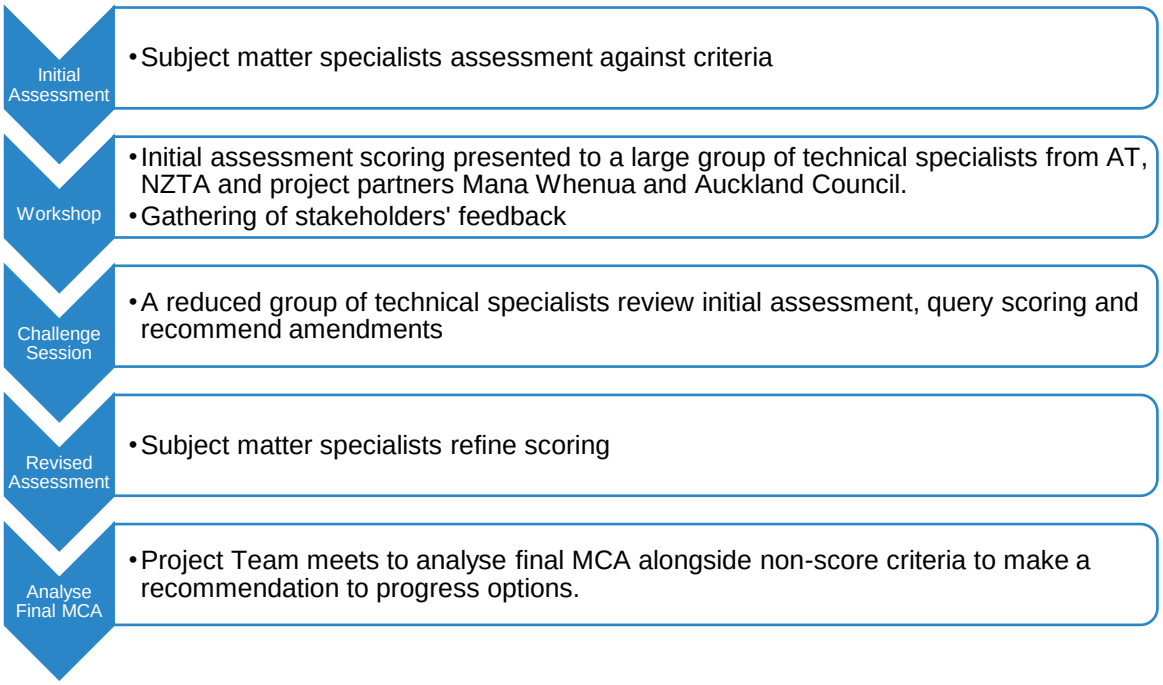


Source: Mott MacDonald / SGA

The MCA framework criteria, alignment of investment objectives with the four well-beings and additional non-scored criteria are explained further in Table 10 below.

The process followed to carry out the MCA is summarised in Figure 26.

Figure 26: MCA Process



Source: Mott MacDonald

Table 10: MCA Criteria

Topic	Criteria	Description
Well-Being: Cultural		
Investment Objective IO3		Ensure accessibility to employment, education, tourism and core services in, and around, Warkworth by maintaining journey times for local trips as close as possible to 2022 levels (after construction of Matakana Link Road and with future infrastructure elsewhere responding to growth).
Heritage	Heritage	Extent of effects on sites and places of value with respect to: heritage buildings, trees, places, archaeology and/or European cultural heritage.
Mana Whenua	Mana Whenua Customary Practice	Access to resources and places of traditional practice.
	Māori communities and wellbeing	Extent of effects on the relationship of Māori to their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other Taonga (tangible and intangible).
	Māori land	Effects on access to marae, papakāinga and Maori land.
	Te Taiao (Air, Land, water, Taonga)	Effect on air land water and other resources based on matauranga Maori (e.g. best stormwater practice)
Mana Whenua Opportunities	Accessibility	Effect on opportunities to improve access to marae, papakainga, Maori land, resources and places of traditional practice.
	Treaty Redress	Opportunities for alignment with existing redress and Treaty principles.
	Te Aranga principles	Implementation of the Te Aranga design principles
	Employment and Community	Effect on opportunities to benefit Māori way of life through access to employment and affordable and efficient transport infrastructure, or for Mana Whenua to strengthen their relationship with communities within their rohe.
	Culture and traditions	Effect on opportunities: to strengthen the relationship of Māori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other Taonga (tangible and intangible), or to provide recognition of sites of significance
	Environment	Effect on opportunities for improvement to air, land, water and other resources based on matauranga Maori.
Well-Being: Social		
Investment Objective IO3		Ensure accessibility to employment, education, tourism and core services in, and around, Warkworth by maintaining journey times for local trips as close as possible to 2022 levels (after construction of Matakana Link Road and with future infrastructure elsewhere responding to growth).
Investment Objective IO4		Improve public transport, walking and cycling choices for trips within Warkworth
Social-Economic Impacts	Land use futures	Impact on future land development, in relation to: the underlying existing urban structure, the alignment of housing delivery with infrastructure delivery, enabling appropriate building typologies, scope for consolidation of residual land and scope for access to neighbouring development.
	Urban design	Effect on opportunities for a quality urban environment (both current and future planned state), particularly relating to: context, place-making, public realm, open space, public-private realm interface and long-term impact on the amenity and character of the surrounding environment.
	Land requirement	Scale of public / private land (area / number of properties / unique status of property) required to deliver the option.
	Social cohesion	Accessibility/connectivity impacts for existing urban areas: employment, communities, shops/services/facilities, open space and coast/rivers/lakes.
	Human Health and Wellbeing	Impacts on any sensitive land uses nearby or consented (residential, childcare centres, hospitals, rest homes, marae and schools), particularly relating to: Air Quality, Contaminated Land and Noise and Vibration.
Social Opportunities	Social Equitability	Effect on opportunities for local training and employment for workplace upskilling., opportunity to help disadvantaged communities or opportunity to use local suppliers and/or ability to access local materials
Well-Being: Environmental		
Investment Objective IO4		Improve public transport, walking and cycling choices for trips within Warkworth
Natural Environment	Landscape / visual	The extent of visual effects on the current and future natural landscape and features such as streams, coastal edges, natural vegetation and underlying topography (particularly with regards to outstanding natural features/landscapes).

Topic	Criteria	Description
	Stormwater	Impact of operational stormwater on the receiving environment, including: life supporting capacity, flooding effects and likely mitigation measures.
	Ecology	Extent of effects on: significant indigenous flora, habitats, indigenous biodiversity, water quality and the ecologies of streams and coasts.
Environmental Opportunities	Climate Change outcomes	Climate Change risk assessment and adaptation options (risk and opportunity). Scope for mitigation of GHG emissions during construction and when operational; Access to renewables; ability to use renewables.
	Ecological Opportunities	Scope for: ecological restoration, implementation of green infrastructure, improvement of ecological corridors / connectivity, preservation of productive land, minimisation of light pollution, improvement of access to water generally and reduction in potable water use.
Well-Being: Economic		
Investment Objective IO1		Support residential and economic growth by increasing journey time reliability.
Investment Objective IO2		Enable land to be developed in line with the FULSS by ensuring there is sufficient capacity at the Hill Street intersection to support development
Investment Objective IO3		Ensure accessibility to employment, education, tourism and core services in, and around, Warkworth by maintaining journey times for local trips as close as possible to 2022 levels (after construction of Matakana Link Road and with future infrastructure elsewhere responding to growth).
Transport	Transport system integration	The extent to which the option achieves: integration with wider network and between modes, resilience to operational incidents or short-term life-line access disruption, reduction of the need to travel and increased access to non-car choices.
	User safety	Safety for all transport users, including people in private vehicles, public transport and walking or cycling
Construction Impacts	Construction impacts on utilities / infrastructure	Requirements for relocation / redesign of existing infrastructure, including impacts on safety, continuity of service, utility providers and integration with other bulk infrastructure.
	Construction Disruption	Construction impacts on people and businesses regarding: traffic, noise, dust, as well as detriment to quality of life, amenity and local businesses/community.
Cost and Construction Risk	Construction costs / risk / value capture	Assessed cost for construction of options including: complexity and risk in construction and programme and extent to which the option can utilise a value-capture mechanism to offset construction costs.
	Maintenance costs	Scale of maintenance costs associated with the option
	Operational costs	Scale of operational costs associated with the option
Transport Opportunities	Behavioural Change / Future Technology Opportunities	Opportunities for the option to integrate with new transport technologies and transport behavioural change initiatives.
Urban Development Opportunities	Housing and future development	Opportunity for the option to increase the volume of housing delivery (e.g. number of houses / timeframe).
	Existing economic opportunities	Ability for the option to contribute / facilitate economic opportunities that are desired with future development (e.g. enabling transport nodes / transport orientated development).
Non-Scored		
Stakeholder Feedback		Stakeholder and key partner feedback, identifying scale / validity of objections, identified preference / proposed changes to options etc.
Policy Analysis		Options alignment with the strategic policy framework including the Auckland Unitary Plan, Auckland Plan with particular consideration to provisions that derive from section 6 of the RMA.
Value for Money		Provide an estimate of likely value for money in conjunction with transport outcomes and construction costs to provide the likely BCR (High/Medium/Low/Very low) for the Long List MCA and the indicative BCR for the Short List MCA.
Resilience		Avoid adverse geology; steep slopes; seismic impacts; other resilience risks (low level infrastructure near coastlines, inundation areas)

Source: Mott MacDonald / SGA

Options were scored from -5 to +5 based on the scale of effect or opportunity they provide. Scoring was undertaken by subject matter specialists, with subsequent challenge sessions to ensure robustness in assessment.

To keep consistency, the same MCA framework was applied to assess the long list and the short list. However, given that greater detail on the effects and opportunities associated with the options was known during the short list assessment, the MCA criteria was slightly adjusted on this phase of the project.

5 Approaches Analysed

Approach: A strategic means for achieving desired outcomes and investment objectives. An approach may be implementable by means of physical works, operational measures or by other interventions.

Table 11 outlines the approaches that were considered to respond to the key problems identified through the ILM.

Table 11: Approaches

Approaches	Description	Implications
1. Land Use	Addresses basis of future demand through changes to development potential including no growth, a different pattern of growth, changing locations of trip attractors.	Unitary Plan and FULSS refresh have been completed
2. Optimisation	Maximising capacity of the intersection or local road network through signal phasing and removing conflicting movements.	A focus to maximise operation of existing layout and minimise size and cost of all options.
3. Supply	Physical upgrades to the intersection including changes to the physical layout and capacity, movements provided and method of control.	Options will be developed to meet future demand and operational requirements.
4. Policy	Policy interventions such as pricing and development controls.	Apply regional policies
5. Mode	Introducing changes which focus on enabling all modes as a viable option.	Mode neutrality
6. Demand	Managing demand through the network to reduce the need to provide additional capacity.	No new programmes

Source: Mott MacDonald

The approaches have been assessed as per **Section 4.1**, considering their potential for contributing towards the investment objectives. All the approaches identified do have this potential, in principle. However, the business case is unable to influence land use as this has already been defined through the Unitary Plan, Future Urban Land Supply Strategy and the Warkworth Structure Plan. All the other approaches may be implemented through the scope of the business case.

A package of interventions, encompassing a combination of approaches, is likely to be more effective than a solution comprising only one approach. Consequently, approaches 2 to 6 were all taken forward to the option development stage.

6 Options Analysed

As outlined by the Assessment Framework, development of options has been carried out in stages, progressing from high-level categorisation of a comprehensive options for the Intersection, through an Initial Long List, Long List, Short List to a Recommended Option in increasing levels of detail.

Options developed by previous studies and local community groups were collected and augmented by further options developed through 'blue-sky' optioneering by the project team. The 30+ options resulting were then sorted by their key characteristics into their 4 categories and 11 sub categories. These included roundabouts, signals, gyratories, overpasses, closing links, opening new links and grade-separation. A representative indicative design was developed for each and tested against the Critical Success Factors (CSFs). Although the assessment found that some designs may perform poorly against at least one CSF, it was considered that all categories should be taken forward for further assessment so that more robust evidence for exclusion or inclusion could be developed.

The 30+ options in the Initial Long List were then divided into their component parts for further assessment. These components could be recombined to form 230 new options, so each component was subjected to a stand-alone performance assessment that sifted out components that would not provide an acceptable level of service compatible with the investment objectives. Components that passed the assessment were then combined into ten Long List options, representative of all the potential combinations.

Each of the Long List options was assessed using the MCA framework. Basic option drawings, showing indicative layouts were developed to assist in understanding the scale and potential physical impacts of the options. The MCA scoring informed a qualitative ranking of options against the overarching 'Four Well-beings' used by SGA. This ranking clearly identified four options that would achieve markedly better outcomes than the remaining six Long List options. These four options were taken forward for further development.

The four options were condensed into three representative designs for public consultation. Further refinement of the options was carried out, informed by emerging information including responses from the consultation, mesoscopic modelling results and details of proposed SGA networks. The refinement provided further resolution to produce two Short List options – one based on a pair of roundabout intersections and one based on a pair of signalised intersections and a new link to SH1 via Falls Street.

The refined Short List designs were analysed to assess their operational performance, costings and value for money, before being assessed using the MCA framework. The MCA assessment found that the two options would deliver closely matched overall outcomes, so further analysis was carried out to better understand the safety outcomes, risks and opportunities, and to refine the costings and value for money assessment.

Taking into account the MCA assessment and further analysis, the recommendation is to progress with the two-roundabout option to the next stage of development, as the Recommended Option.

This recommendation is based on the assumptions and information available at the time of writing. With multiple investigations underway in Warkworth there is a level of uncertainty as to what the future wider network will look like. It may be necessary to review these options again once the detailed investigations for the SGP projects are carried out. It is not impossible that a reassessment at that point could lead to a revised recommendation in favour of the two signalised intersections.

6.1 Long List Categorisation

Option: Physical or operational intervention as it is intended to be implemented. Options encompass alternative sites, forms, routes and methods of undertaking working. Related options may exist where additional works are added to mitigate adverse effects of an original option.

Source: *NZTA Multi Criteria Analysis for Transport Business Cases Guidance*

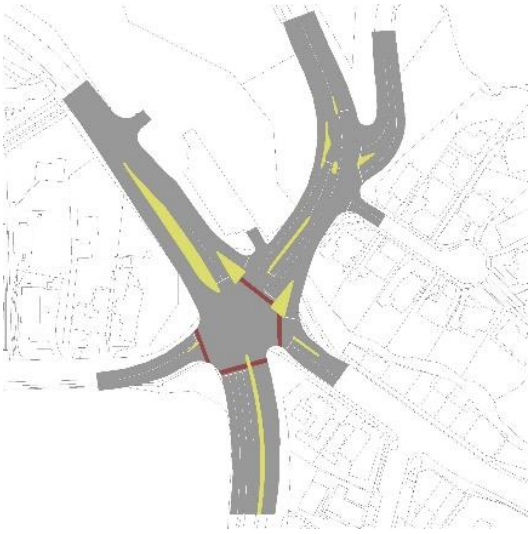
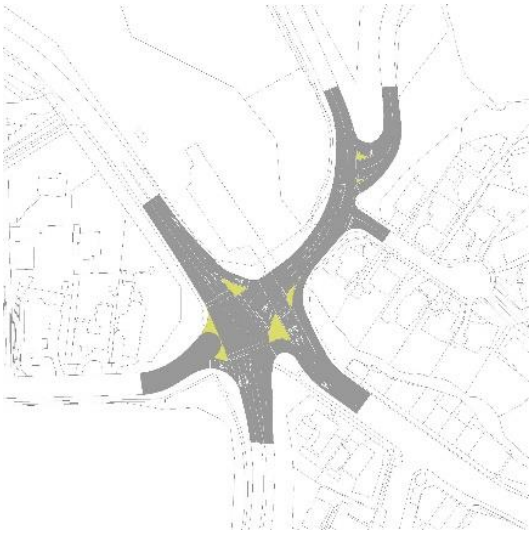
A number of previous transport studies considered various options to address the future demands and deficiencies along SH1 within the Warkworth area as noted in **Section 1.3.**

Additional to these studies, various options have been developed by local community groups. Each of these options, plus any new options identified by the project team were collated and sorted into categories and sub categories. This process consolidated a large number of options (30+) by their defining features, allowing for assessment of this initial long list against the critical success factors.

The initial long list was sorted into 4 categories and 11 sub categories. These are summarised in the table below, providing an indicative design layout and summary of each sub category's key defining features. Further details are provided in **Appendix D.**

Table 12: Long List Categorisation

Category	Sub Category	Indicative Drawing / Key Features
1. Upgrade to existing intersection		• Minimal land-take required • Least amount of civil works required to implement • No impact on identified constraints • Fewer consenting risks due to minimal land take
	1. Roundabouts	
		 • Reduces conflict points • Simplifies movements • Provides clear indication of priority • Reduces speed at the approaches • Opportunity to signalise crossings • Requires some convoluted movements through the junction for some trips

Category	Sub Category	Indicative Drawing / Key Features
	2. Signalised	
		
		• Phased movements • Offers maximum degree of control • Space efficient • Greater traffic delays • Requires maintenance and operation of traffic lights
	3. Close movements	
		
		• Reduces conflict points • Simplifies intersection • Requires traffic to reroute onto alternative corridors for some trips • Traffic reduction / removal in closed streets making more people-friendly
	4. Operational improvements	
		
		• Eg: changes of priority / phase timing / island relocation • Low cost • Small change / benefit • Short period of implementation / minimises disruption

Category	Sub Category	Indicative Drawing / Key Features
2. Diverting movements		• Conflicting movements separated through a series of new intersections • Links SH1 with Matakana Rd and Sandspit Rd meaning traffic from the north can access the eastern beaches without having to go through the main intersection • Requires additional land take and possibly the construction of a new bridge over the river • Due to larger area affected may impact on identified constraints (Kowhai Park, heritage asset, notable trees, carpark and public toilet) • Greater consenting risks related to land take, including SEA and reserve land
	5. Triangular gyratory (partial)	
		• Simplifies Hill Street Intersection • Provides good connectivity between Warkworth Town Centre – Carpark – Kowhai Park • Adds complexity to Matakana Rd / Sandspit intersection • Trips from Elizabeth Street south of SH1 forced to reroute
	6. Triangular gyratory (full)	
		• Could cause driver confusion • Offers various routes to access key points • Minimises delays of certain movements

Category	Sub Category	Indicative Drawing / Key Features
	7. Triangular roundabout	 • Significant land take • Removes existing carpark and public toilet • Provides poor connectivity between Warkworth Town Centre – Kowhai Park • Unutilised land space
3. Grade Separated		• Turning movements are removed from SH1 • Reduces conflict points • Can facilitate large turning flows • Expensive to implement • Likely to require land take which could negatively impact on consenting costs and timeframes • Longer construction period / disruption • Depending on design, may have an adverse impact on identified constraints
	8. Single point interchange	 • SH1 through movements pass beneath local network • Good East-West connectivity for vehicles • Poor East-West connectivity for active modes • Visually intrusive

Category	Sub Category	Indicative Drawing / Key Features
	9. Overpass with roundabout	
		• SH1 through movements pass over local network • Visually intrusive • Roundabout simplifies turning movement • Poor East-West connectivity for active modes
4. New Links		• Add new connections between existing links • Provides additional network resilience and potential new walking and cycling corridors • Reduces conflict points • Possible opposition from affected residents
	10. Falls St Link	
		• Adds a new exit point from Warkworth town centre into SH1 • Requires parking restrictions on Falls St

Category	Sub Category	Indicative Drawing / Key Features
	11. Shoesmith Link	
		 • Hill St diverted to Shoesmith St via new connection through Shoesmith Reserve • New signalised intersection at Shoesmith St / SH1 • No vehicular access from Hill St to existing intersection • Fewer conflicts at Hill St intersection

Note: Drawings shown are high-level examples of the type of options that could fall within the subcategory and are included in this document as a visual aid to understand the concept. Crossings are indicative only.

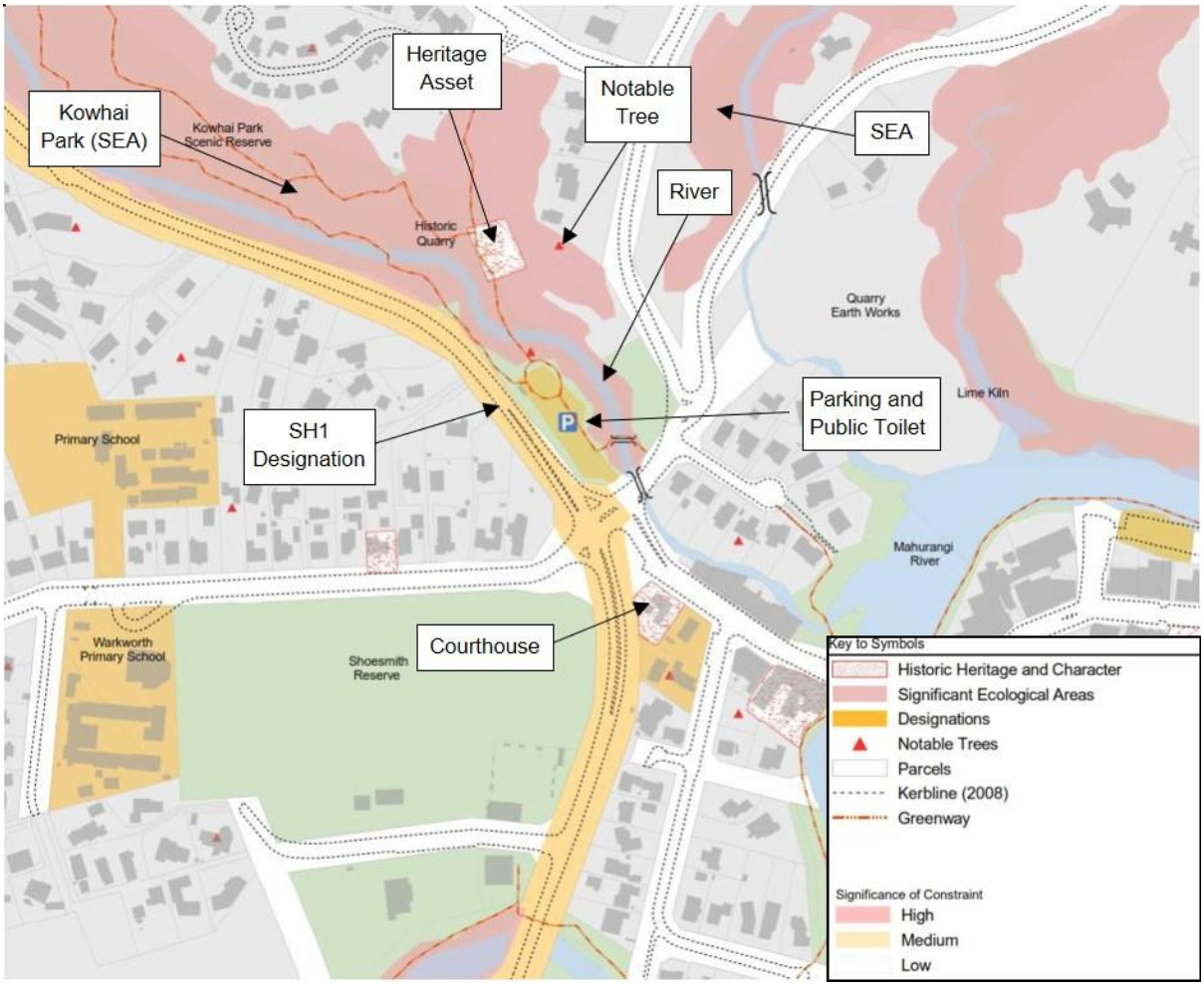
6.2 Initial Long List Assessment

The CSF assessment of the initial long list was conducted by the Mott MacDonald project team using the assessment methods outlined in **Section 4.2.**

6.2.1 Constraints Mapping

Constraints mapping was undertaken using Auckland Unitary Plan layers for heritage, significant trees and Significant Ecological Areas (SEAs) as illustrated in Figure 27.

Figure 27: Constraints Mapping



Source: Mott MacDonald using Auckland Council GeoMaps data
NB: Mahurangi River also identified as a significant constraint but shown in blue for clarity

The indicative designs for the option subcategories were overlaid onto the constraint map to assess where the design was likely to infringe upon constraints of high, medium and/or low significance.

6.2.2 Engagement with Mana Whenua

Mana Whenua groups were not present to undertake the CSF assessment and therefore this criterion has been left unscored. However, Mana Whenua groups were included as partners to the MCA process, ensuring the long list options have been assessed against their alignment with Mana Whenua values.

6.2.3 Roads and Streets Framework Assessment

The Roads and Streets Framework (RASF) provides guidance for street development in Auckland. Through the RASF process, roads and streets are assigned a street typology based on the relative importance of movement and place. The outcomes of the RASF process will be used to inform design decisions through the option development and refinement.

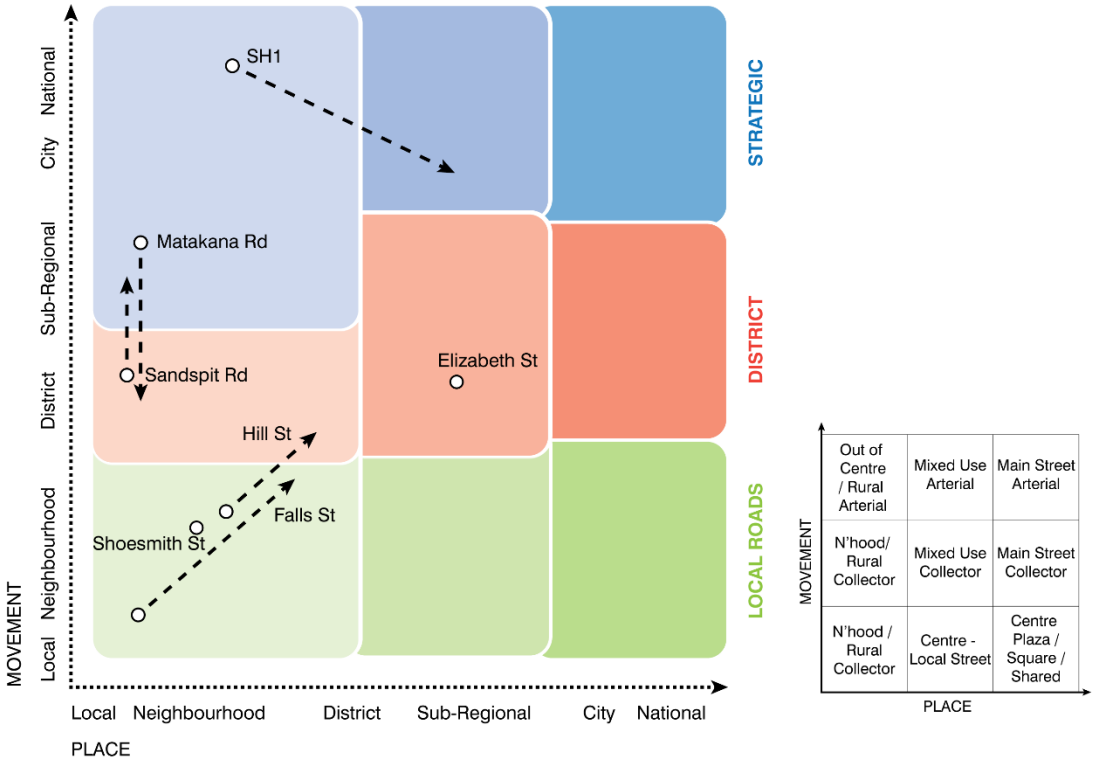
A workshop was held in June 2018 with AT technical specialists to identify the existing and future street typology of the five streets that form the Hill St intersection, as well as those that may accommodate new connections:

- Hill Street;

- State Highway 1;
- Sandspit Road;
- Matakana Road;
- Elizabeth Street;
- Falls Street; and
- Shoesmith Street.

Following the release of the SGA Integrated Transport Assessment (ITA) in January 2019, the assessment was updated to take into account changes to the future transport network. The outcome of the workshop is included in **Appendix C**. Figure 28 displays the agreed existing and future street typologies of the streets above.

Figure 28: Roads and Streets Framework



Source: Mott MacDonald

Table 13 outlines the future typologies and justification for each of the streets related to the Hill Street intersection improvements.

Table 13: Future Street Typologies

Street	Change	Comments	Final Typology
Hill Street	↗	Additional development at the western end of Hill Street will increase movement function, even with the Western Collector. No significant changes to the Place function are anticipated, although school may grow.	Neighbourhood Collector
State Highway 1	↘	Future development and frontage onto SH1 increases place function. P2Wk and MLR provide bypass so movement function decreases by one level.	Mixed Use Collector

Street	Change	Comments	Final Typology
Sandspit Road	↑	Future development in the eastern beaches settlements will increase importance of movement function. No additional development on Sandspit Road close to intersection due to conservation significance but will be upgraded to urban standards.	Out of Centre Arterial
Matakana Road	↓	Place function remains the same as limited development along section of Matakana Rd close to intersection. MLR provides a bypass and so movement function will remain high but decrease slightly compared to existing.	Neighbourhood Collector
Elizabeth Street	=	Future intensification of high street retains sub-regional place function. As the major local service centre, it will continue to attract a lot of traffic and will be the hub for PT movement in Warkworth.	Mixed Use Collector
Falls Street	↗	Intensification of town centre around Fall Street will increase place and movement functions. This will be further enhanced if access to Falls St is opened up from SH1 to provide additional access to town centre.	Local Street
Shoesmith Street	=	Currently Shoesmith St has neighbourhood function as although a dead-end road it provides access to the playing fields. Any option to connect Shoesmith St to Hill St will increase its movement function.	Local Street

Source: Mott MacDonald

Each of the option subcategories was considered against the future typology for the streets in the vicinity of the intersection to assess whether the scale of the solution would be appropriate for central Warkworth.

6.2.4 Operational Assessment

The operational assessment was undertaken for each of the option subcategories, based on consideration of extent to which key journeys could be provided for within a design within that subcategory. Journeys were considered for all modes (private vehicles, public transport and active modes) using the hierarchy of journeys defined in **Section 3.2.2** (Table 4).

6.2.5 Critical Success Factors Assessment Summary

Table 14 summarises the assessment of the option subcategories against the critical success factors.

Table 14: Critical Success Factor Assessment

Category	Subcategory	Heritage	Trees	SEA	Mana Whenua	Scale	Journeys
1. Upgrade to existing intersections	1. Roundabouts						
	2. Signalised						
	3. Close movements						
	4. Operational improvements						
2. Diverting movements	5. Triangular gyratory (partial)						
	6. Triangular gyratory (full)						
	7. Triangular roundabout						
3. Grade separated	8. Single point interchange						
	9. Overpass with roundabout						

Category	Subcategory	Heritage	Trees	SEA	Mana Whenua	Scale	Journeys
4. New links	10. Falls Street						
	11. Shoesmith St						

Source: Mott MacDonald

Assessment Key

- Meets criteria / unlikely to impact
- Further investigation required / could impact
- Does not meet criteria / likely to impact
- Critical Flaw
- Not assessed

The CSF assessment indicates that the scale of the grade separated options is inconsistent with the Warkworth context. The options that divert movements could potentially impact on local heritage and tree assets. All options have the potential to provide for all the key movements.

A grade separated solution has been strongly supported by parts of the Warkworth community and is the only option inconsistent with the critical success factors. Therefore, to ensure transparency in the decision to discount these options, this category was taken forward to the full MCA analysis to provide robustness and greater evidence for this decision.

6.3 Long List Development

As outlined above, a significant number of options had been identified through previous studies and by the Warkworth community. 'Blue skies' optioneering was undertaken by the project team to identify any further options that had not previously been documented. Over 30 options were collated through this process. The full list of options is provided in **Appendix D**.

6.3.1 Option Generation

The initial collation of options comprised potential changes to six intersections:

- Sandspit Road / SH1 / Hill Street;
- Sandspit Road / Matakana Road;
- Elizabeth Street / Sandspit Road;
- SH1 / Falls Street (new intersection);
- SH1 / Falls Street / Shoesmith Street (new intersection); and
- SH1 / Shoesmith Street (new intersection).

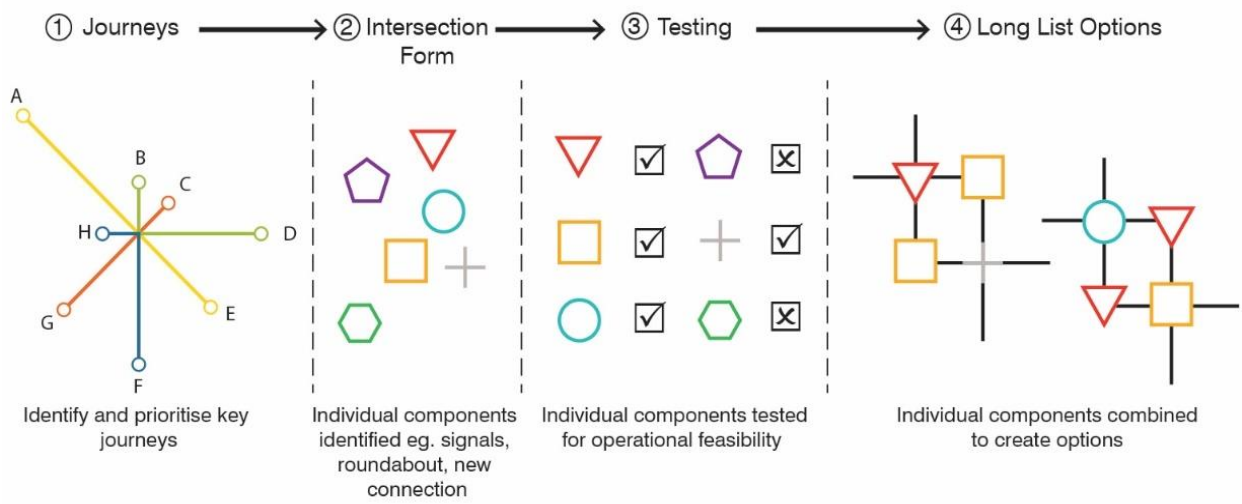
Breaking each of the options into its component parts resulted in a list of 230 potential options. To rationalise the number of options to be included as part of the long list, each of the component parts was tested through SIDRA traffic modelling software. Demands were adjusted to reflect any wider network changes that would result from the option (such as the gyratory options).

This analysis tested the performance of each component under 2036 demands and therefore whether the option would work as part of a long-term solution. Intersection options that operated at Level of Service (LoS) F or worse (delays greater than 80 seconds) were not considered for the long list as they would be unable to meet the investment objectives. However, there is the potential for discounted options to form part of an interim stage.

Further detail on this testing has been provided in the Modelling Technical Report in **Appendix E**.

Intersection options that performed at an acceptable level were subsequently aggregated to form a longlist of ten options that were representative of the scale and philosophy of all potential options. Figure 29 provides an overview of the long list development process.

Figure 29: Long List Development



Source: Mott MacDonald

Table 15 outlines the intersection forms that were tested at each location, and whether they were taken forward to develop long list options.

Table 15: Intersection Testing

Intersection	Intersection Form	Pass/Fail
Hill St / SH1	Existing configuration (including optimisation)	N
	Single lane roundabout	N
	Double lane roundabout	Y
	Five-legged signalised intersection (2009 preferred Opus design option)	N
	Alternative Hill St access	Y
	Alternative Elizabeth St access	Y
	Major triangular gyratory	Y
Matakana Rd / Sandspit Rd	Existing configuration (including optimisation)	N
	Single lane roundabout	N
	Double lane roundabout	Y
	Change priorities	N
	Signalised - single approach lanes	N
	Signalised - double approach lanes	Y
	Limited Matakana Rd - restricted movements	Y
Elizabeth St / Sandspit Rd	Left in / left out at Elizabeth St	Y
	Left in only at Elizabeth St	Y
Falls St / SH1	Left in / left out at Falls St	Y
	Full Movements / give way at Falls St	N
	Full Movements / signals at Falls St	Y
Falls St / Shoesmith St / SH1	New crossroads at Shoesmith St /Falls St / SH1	Y
Shoesmith St / SH1	New Hill Street connection at Shoesmith St - Full movements / Signals	Y

Source: Mott MacDonald

Appendix E provides the full assessment of each of the intersection forms, and the evidence that supports taking them through to the long list formation or not. As stated above, the options were assessed against 2036 demands to test their suitability for the final design year.

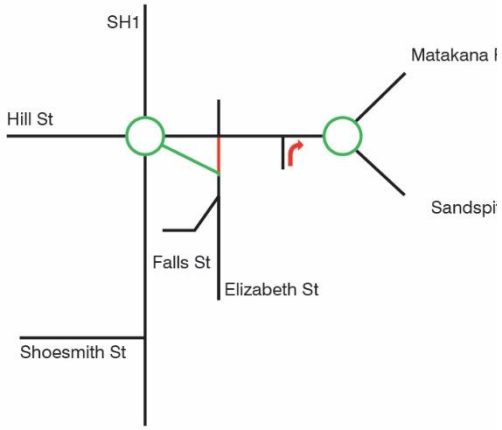
6.3.2 Long List Options

Following the testing, the components that passed were aggregated into nine options that are representative of the range of options available. An additional grade separated was also included in the long list, similar to that developed by the Warkworth community. This option was included in the long list to ensure that it would be given full consideration, in line with the aspirations of supporters amongst the local community. This option was subsequently tested through SIDRA to confirm it met the same performance standard as the other options.

The general approach to option development was to simplify the movements passing through the Hill Street intersections, and to remove the complexity and conflicts that contribute to the existing issues. The outcome of this approach is a range of options that provide different scales of intervention, building up from alterations to existing intersections through to new links, and grade separation. Table 16 provides an overview of the 10 long list options.

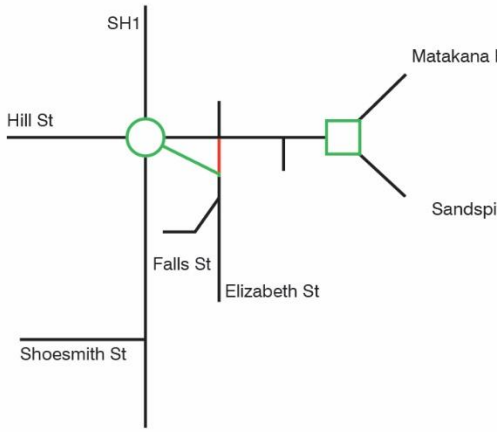
Table 16: Long List Options

Option 1: Hill St Roundabout plus roundabout at Sandspit Rd / Matakana Rd



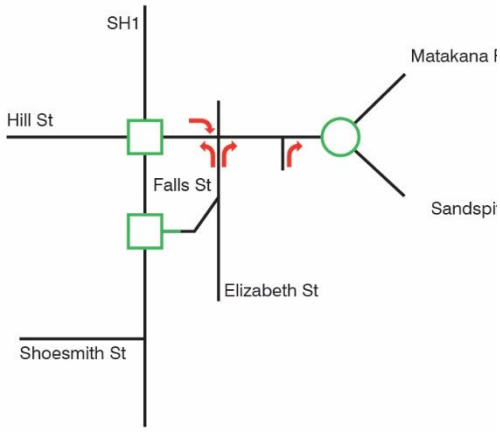
- Elizabeth St connected to main Hill St intersection through new roundabout
- New roundabout at Sandspit Rd / Matakana Rd
- All existing movements provided for
- Potential to stage option with single / dual circulating roundabouts
- Reduction in number of conflicts / opposing movements
- Reduction in number of intersections by incorporating Elizabeth St into main Hill St intersection

Option 2: Hill St Roundabout plus signals at Sandspit Rd / Matakana Rd



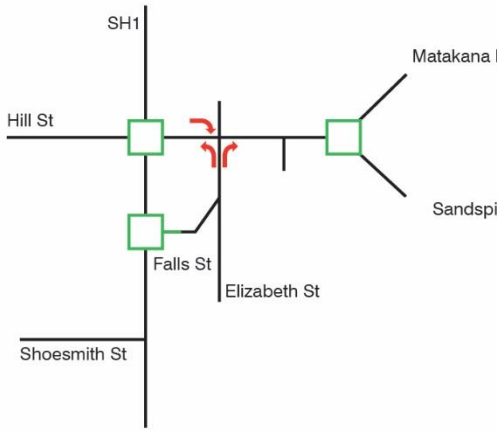
- Elizabeth St connected to main Hill St intersection through new roundabout
- New signalised intersection at Sandspit Rd / Matakana Rd
- All existing movements provided for
- Potential to stage option with single / dual circulating roundabouts
- Reduction in number of intersections by incorporating Elizabeth St into main Hill St intersection
- Reduction in number of conflicts / opposing movements
- Ability to manage flows at Sandspit Rd / Matakana Rd through signals
- Incorporates sub categories from the Initial Long List: Roundabout and Signals

Option 3: Alternative access to Elizabeth Street through Falls St plus roundabout at Sandspit Rd / Matakana Rd



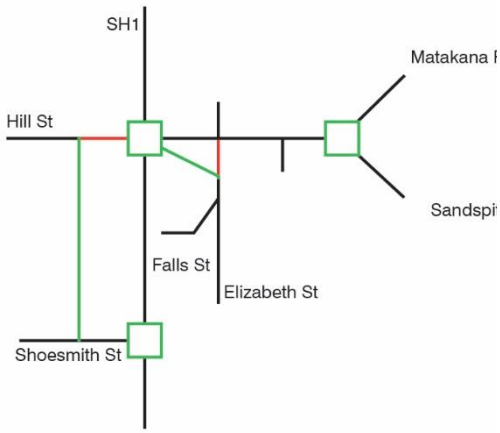
- Changes to signals at main Hill St intersection
- New roundabout at Sandspit Rd / Matakana Rd
- Movements restricted at Elizabeth St, to allow left-in only
- New connection from Falls St to SH1 via a signalised intersection
- Simplification of Elizabeth St access reduces conflicts and impacts of closely spaced intersections
- Roundabout at Sandspit Rd / Matakana Rd allows for access to Elizabeth St from SH1 north
- Falls St connection reduces demands at Hill St
- Incorporates sub categories from the Initial Long List: Roundabout, Signals, Operational Improvement, New Link and Closed Movement.

Option 4: Alternative access to Elizabeth Street through Falls St plus signals at Sandspit Rd / Matakana Rd



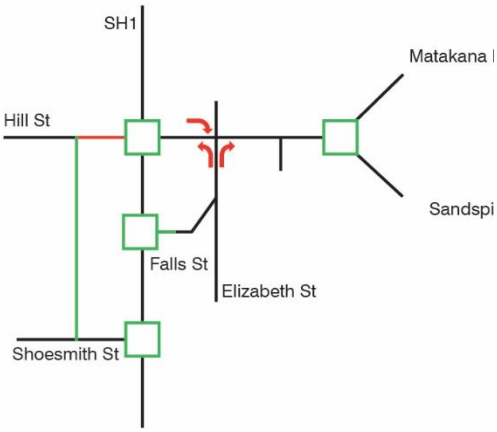
- Changes to signals at main Hill St intersection
- New signalised intersection at Sandspit Rd / Matakana Rd
- Movements restricted at Elizabeth St, to allow left-in only
- New connection from Falls St to SH1 via a signalised intersection
- Simplification of Elizabeth St access reduces conflicts and impacts of closely spaced intersections
- Falls St connection reduces demands at Hill St
- Falls St required for access to Elizabeth St from SH1
- Incorporates sub categories from the Initial Long List: Signals, Operational Improvement, New Link and Closed Movement.

Option 5: Alternative access to Hill St through Shoesmith St plus signals at Sandspit Rd / Matakana Rd



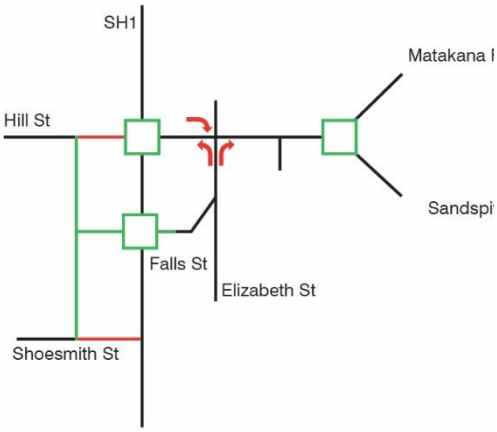
- Elizabeth St connected to signals at Hill intersection
- New signalised intersection at Sandspit Rd / Matakana Rd
- Hill St diverted to Shoesmith St via new connection
- New signalised intersection at Shoesmith St / SH1
- No vehicular access from Hill St to existing intersection
- Fewer conflicts at Hill St intersection
- Reduction in number of intersections by incorporating Elizabeth St into main Hill St intersection
- Incorporates sub categories from the Initial Long List: Signals, Operational Improvement, New Link and Closed Movement.

Option 6: Alternative access to Hill St and Elizabeth St plus signals at Sandspit Rd / Matakana Rd (3 T intersections)



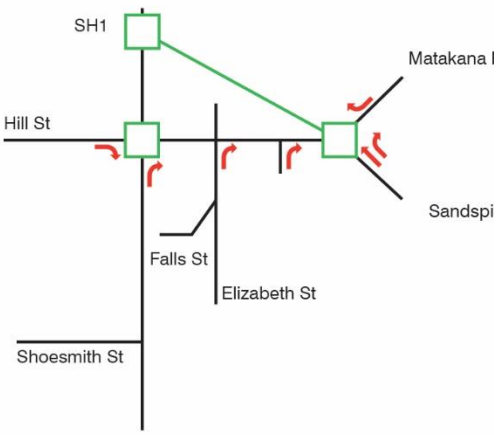
- Changes to signals at main Hill St intersection
- New signalised intersection at Sandspit Rd / Matakana Rd
- Hill St diverted to Shoesmith St via new connection
- New signalised intersection at Shoesmith St / SH1
- No vehicular access from Hill St to existing intersection
- Fewer conflicts at Hill St intersection
- Movements restricted at Elizabeth St, to allow left-in only
- New connection from Falls St to SH1 via a signalised intersection
- Falls St connection reduces demands at Hill St
- Falls St required for access to Elizabeth St from SH1
- Incorporates sub categories from the Initial Long List: Signals, Operational Improvement, New Link and Closed Movement.

Option 7: Alternative access to Hill St, Elizabeth St and Shoesmith St plus signals at Sandspit Rd / Matakana Rd (New crossroads at Falls St)



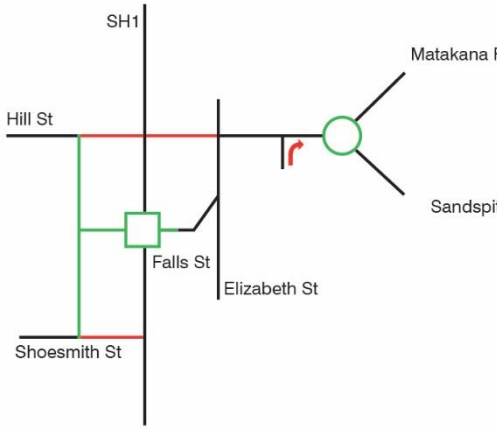
- Changes to signals at main Hill St intersection
- New signalised intersection at Sandspit Rd / Matakana Rd
- Hill St and Shoesmith St diverted via new connection to SH1
- New connection from Falls St to SH1
- New signalised intersection at diverted Hill / Shoesmith link, Falls St and SH1
- No vehicular access from Hill St to existing intersection
- Fewer conflicts at Hill St
- Movements restricted at Elizabeth St, to allow left-in only
- Simplification of Elizabeth St access reduces conflicts and impacts of closely spaced intersections
- Relocation of Shoesmith intersection reduces number of intersections along SH1
- Incorporates sub categories from the Initial Long List: Signals, Operational Improvement, New Link and Closed Movement.

Option 8: Triangular gyratory



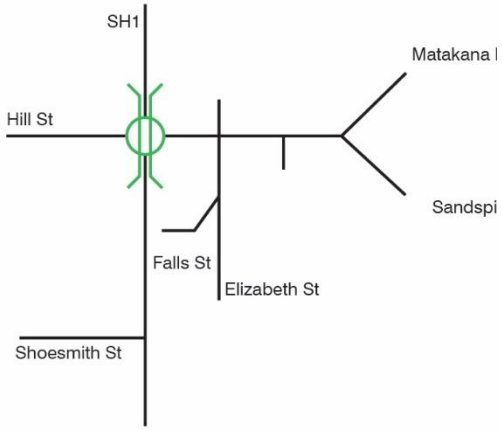
- New connection from northern leg of SH1 to Sandspit Rd / Matakana Rd through Kowhai Park
- New signalised intersection at Sandspit Rd / Matakana Rd
- Right turns from Hill St, Elizabeth St, Millstream Place, Sandspit Rd, Matakana Rd and SH1 south restricted
- One-way circulation / gyratory
- No conflicting movements due to one-way system
- Incorporates sub categories from the Initial Long List: Signals, and Full Gyratory.

Option 9: Relocate intersection to Falls St plus roundabout at Sandspit Rd / Matakana Rd

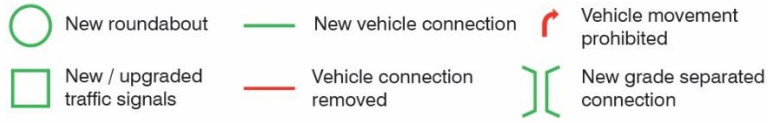


- New roundabout at Sandspit Rd / Matakana Rd
- No vehicular access from Sandspit Rd to SH1
- Hill St and Shoesmith St diverted via new connection to SH1
- New connection from Falls St to SH1
- New signalised intersection at diverted Hill / Shoesmith link, Falls St and SH1
- No vehicular access from Hill St / Sandspit Rd to existing intersection
- Removal of signals at main Hill St intersection
- Incorporates sub categories from the Initial Long List: Roundabout, Signals, New Link and Closed Movement.

Option 10: Grade separation of north-south traffic over roundabout



- New roundabout at main Hill St intersection
- Grade separated connection for north-south journeys on SH1
- Potential for underpass connection from SH1 (north) to Sandspit Rd
- Dominant flow (north-south) separated from conflicting movements
- Incorporates sub categories from the Initial Long List: Roundabout and Grade Separation.



Source: Mott MacDonald

6.4 Long List Assessment

Each of the Long List options was assessed using the MCA framework outlined in section **4.3.** Basic option drawings, showing indicative layouts were developed to assist in understanding the scale and potential physical impacts of the options. Individual criteria were assigned to subject matter specialists, including Mana Whenua, to assign ratings.

At this stage of option development, it was assumed that all options would provide dedicated facilities for people travelling by bike. However, no design work or optioneering for cycle facilities was undertaken as part of the long list assessment. The Long List MCA considered the impacts of different intersection types and new connections when assessing their impacts on people travelling by bike.

Non-scored criteria were taken into account for the long list assessment as follows:

- **Stakeholder Feedback:** stakeholder inputs were recorded through the various engagements and this was analysed when making a recommendation;
- **Policy Analysis:** alignment with policy was considered when developing scores for all the scored criteria;

- **Value for Money:** the likely costs of options were considered when scoring criteria under the 'Economic' well-being; and
- **Resilience:** this was not expected to be a differentiator for the long list options as the resilience risks are tied to the location, which is fixed for all options**.**

A long-list assessment workshop was held on 28th June 2018 with project stakeholders and partners to review the scoring, gather feedback and identify an emerging shortlist. The Workshop 4 (Long List options Assessment) memo is provided in **Appendix C.**

A challenge session was consequently held with AT technical specialists to understand the rationale behind the scores and refine scoring. The workshop memo including the final MCA assessment table and the scoring guidance can be found in **Appendix C.**

To identify the shortlist of options, the project team ranked the options from 1 to 5 within each wellbeing (descending order). This was a qualitative assessment, rather than totalling the individual scores the positives and negatives of the options were balanced against each other. This step provided the relative performance of each option against the four well-beings, summarised in Table 17.

Table 17: Long List Well-Being Ranking

Ranking	Options	Justification
Well-Being: Cultural		
1	3, 4	Options 3 and 4 achieve broadly positive or neutral Cultural Well-Being impacts, with very low negative (-1) impacts in no more than three criteria.
2	1, 2, 9	Options 1, 2 and 9 achieve mixed Cultural Well-Being impacts, with low negative (-2 or -1) impacts in no more than five criteria.
3	5, 7	Options 5 and 7 result in broadly negative Cultural Well-Being impacts that are generally very low (-1) with no more than one low (-2) impact.
4	6, 8	Options 6 and 8 result in broadly negative Cultural Well-Being impacts, including several that are low or moderate (-2 or -3).
5	10	Option 10 results in broadly negative Cultural Well-Being impacts, including several that are moderate or high (-3 or -4).
Well-Being: Social		
1	2, 4	Options 2 and 4 achieve broadly positive or neutral Social Well-Being impacts, with low or very low negative (-2 or -1) impacts in no more than three criteria.
2	3	Option 3 achieves varied Social Well-Being impacts, with negative impacts for three criteria, including one moderate negative (-3) and two low negative (-2 or -1) impacts.
3	1, 5, 6, 7	Options 1, 5, 6 and 7 result in mixed Social Well-Being impacts that are generally low or very low (-2 or -1) with no more than one high (-4) impact.
4	8, 9	Options 8 and 9 result in broadly negative or neutral Social Well-Being impacts, including several that are moderate or high (-3 or -4).
5	10	Option 10 results in largely negative or neutral Social Well-Being impacts, including several that are moderate or very high (-3 or -5).
Well-Being: Environmental		
1	2, 4	Options 2 and 4 achieve mixed Environmental Well-Being impacts, with very low negative (-1) impacts in three criteria.
2	1, 3, 5	Options 1, 3 and 5 achieve varied Environmental Well-Being impacts, with negative impacts for three criteria, including one moderate or low negative (-3 or -2) impacts.
3	6, 7, 9	Options 6, 7 and 9 result in varied Environmental Well-Being impacts with negative impacts for three criteria, including one high negative (-4) impact.
4	8	Option 8 achieves varied Environmental Well-Being impacts with negative impacts for three criteria that are either moderate or high (-3 or -4).
5	10	Option 10 results in largely negative or neutral Environmental Well-Being impacts, including several that are very high (-5).
Well-Being: Economic		
1	1, 2, 4	Options 1, 2 and 4 achieves mixed Economic Well-Being impacts, with low or very low negative (-1 or -2) impacts in no more than five criteria.
2	3	Option 3 achieves varied Economic Well-Being impacts, with negative impacts for three criteria, including two moderate negative (-3) impacts.

Ranking	Options	Justification
3	5, 6, 7	Options 5, 6 and 7 results in varied Economic Well-Being impacts with negative impacts for three criteria, including one high negative (-4) impact.
4	8, 9, 10	Option 8, 9 and 10 achieves varied Environmental Well-Being impacts with negative impacts for three criteria that are either moderate or high (-3 or -4).

Source: Mott MacDonald

These rankings were then reviewed to identify the shortlist. Table 18 shows the results of this analysis, highlighting the shortlisted options.

Table 18: Long List Assessment and Short List Summary

Option	Well-Being Ranking				Ranking	Shortlist
	Cultural	Social	Environment	Economic		
1	2	3	2	1	4	Yes
2	2	1	1	1	2	Yes
3	1	2	2	2	3	Yes
4	1	1	1	1	1	Yes
5	3	3	2	3	5	No
6	4	3	3	3	7	No
7	3	3	3	3	6	No
8	4	4	4	4	9	No
9	2	4	3	4	7	No
10	5	5	5	4	10	No

Source: Mott MacDonald

Options 1, 2, 3 and 4 were identified to be taken forward as the short list options for refinement and further assessment. The shortlist options include the top ranked option against each of the four well-beings. No other options were assessed as performing best against one of the well-beings and only Option 5 ranked second against any of the well-beings. There is therefore a clear demarcation between Options 1 to 4 and Options 5 to 10. This demonstrates clearly that Options 1, 2, 3 and 4 are likely to provide the best outcomes and have the lowest adverse impacts.

The component parts of the four options was taken forward for further refinement through the shortlist development. For the shortlist, the options have been renamed as follows:

- Long List Option 1 was renamed as Short List Option A;
- Long List Option 2 was renamed as Short List Option B;
- Long List Option 3 was renamed as Short List Option C; and
- Long List Option 4 was renamed as Short List Option D.

6.5 Short List Refinement

Following the shortlisting process, an evaluation of the merits of each option element was carried out. This evaluation considered an assessment against the investment objectives as well as consideration of a series of factors as discussed in the following subsections.

Alignment with SGA

The SGP for Warkworth is being developed in parallel to the Hill Street intersection improvements. The two projects support each other in delivering an effective transport network for Warkworth. An ITA to support the Warkworth Structure Plan was developed in late 2018 and outlines the scope and timing of the Supporting Growth transport network for Warkworth. The short list options have been cross-checked against SGP network to ensure that there are no major inconsistencies or conflicts in the planned improvements.

Both the SGP and Hill Street Intersection Improvements recognise that a multi-modal solution is required to effectively meet the demands of growth. Significant improvements to the walking and cycling networks are planned within the SGP to facilitate a greater uptake of these modes. Each of the options developed as part of the Hill Street Intersection Improvements includes walking and cycling facilities that directly connect with the networks identified within the SGP.

In September 2018, AT Metro launched the new public transport network for Warkworth and the Kowhai Coast. The New Network includes new operational bus routes, and future planned services. This network is an important component of achieving the mode shift targets for Warkworth and supports the strategy of not providing significant amounts of vehicular capacity.

Access to Warkworth Town Centre via Elizabeth Street

Mana whenua recognise the importance of access along Elizabeth St where the Courthouse building (a commercial redress) is located. Reduction of through traffic along Elizabeth Street would provide opportunity for enhancing the area. Feedback received from representatives of the community during the long list assessment process revealed the importance of Elizabeth Street as the main entrance into the town centre. The restriction of access via Elizabeth Street included in shortlisted Options C and D was perceived as adversely affecting businesses and it was strongly opposed.

The restriction of access to Elizabeth Street and the town centre was incompatible with the public transport network for Warkworth put forward in the draft SGP ITA.

Consequently, it was decided to refine the design of Options C and Option D to incorporate a direct inbound link into Elizabeth Street giving access to the Town Centre for vehicles travelling from the north (SH1 north approach) and the west (Hill Street approach).

SH1 / Bank Street connection

Initial concept designs of Options C and D included a new signalised connection of Bank Street with SH1 to provide an alternative access in and out of Elizabeth Street.

As discussed above, the inclusion of a direct link into Elizabeth Street from the main intersection at Hill Street for access into the Town Centre would remove the need to provide the inbound link at Bank Street.

This design refinement would simplify considerably the layout and operation of the new connection and would be consistent with the street classification of Fall Street and Bank Street as local streets (see RASF attached to **Appendix C**)**.**

Traffic modelling of the short-listed options was carried out in SIDRA software to provide an indicative assessment of how they will perform (further details provided in **Appendix E**). The options were coded into the P2T SATURN model to extract demand flows for the 2026 S0 Scenario. Under this scenario, the only network improvements from the existing situation are the completion of the Ara Tūhono connection and the Matakana Link Road.

The model showed that the Bank Street connection showed very limited inbound traffic from SH1 (fewer than 100 vehicles per day). This is not a high priority movement as defined in **Section 3.2.2.** since these vehicles have an alternative access route through Whitaker Road.

In order to accommodate and inbound and outbound movement at Bank Street, right turn bays for turning movements would need to be provided in SH1 on both approaches, meaning that SH1 would need to be four lanes wide for traffic. Queuing traffic in the southern approach of the intersection could conflict with through traffic and could create a bottleneck at Shoesmith Bridge (2 lanes wide).

For these reasons, the both-ways element at Bank Street of Options C and D was discounted as a viable option, due to the extra space required for minimal gain.

This would also allow more space to be allocated to walking and cycling through this connection, enhancing connectivity between the Town Centre and the west part of Warkworth and reducing the severance effects of SH1.

Modelling testing was also carried out in SIDRA to assess the merits of combining Option A and B (roundabout at Hill Street intersection) with a connection through Bank Street. This variation is thought to simplify the Elizabeth Street approach of the roundabout and improve its operational performance. However, modelling results show similar performance to the roundabout without simplification. This is because the outbound traffic diverted from Elizabeth Street would increase pressure on the SH1 southern approach. Therefore, this element is not adding additional benefit for the extra space required and it was not progressed.

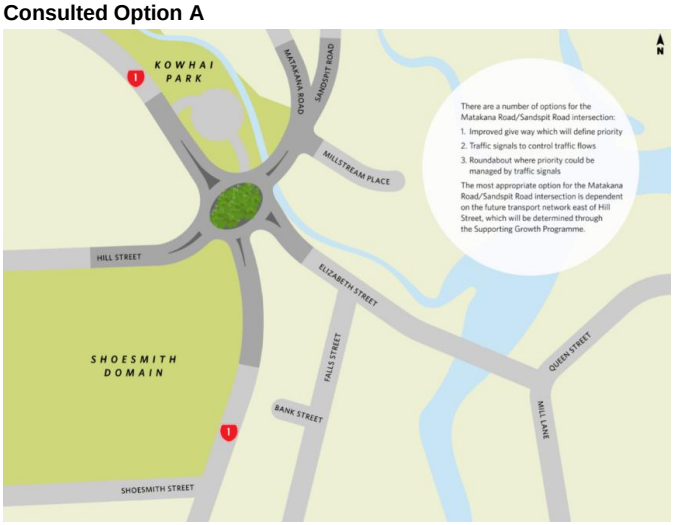
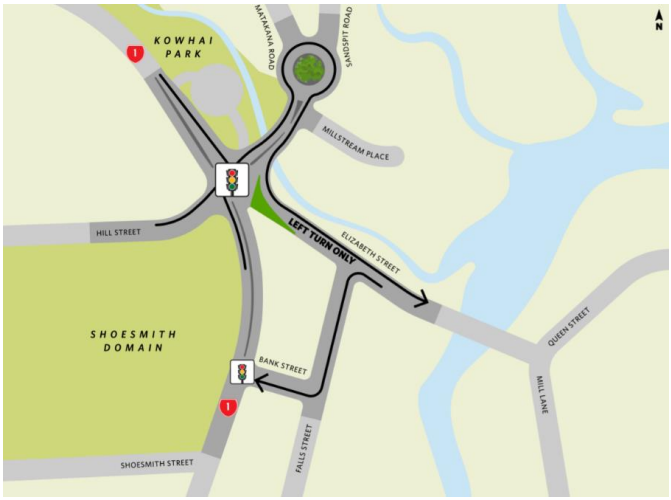
Public Consultation

Public consultation was undertaken over a period of four weeks from 20 November to 14 December 2018. At the time of the consultation the refinement of the short list was not completed so the public was consulted on one option from A and B (roundabout at Hill Street intersection), and one option from C and D (signals at Hill Street intersection with new connection). An option variation was also consulted on to gauge the public's views on proving a left turn only movement into Elizabeth Street, with access to Warkworth town centre via Whitaker Road or a roundabout at the Matakana Road / Sandspit Road intersection. All of the potential options can be derived from the component parts of the consultation options and provided the public with a representation of the different approaches. Table 19 below summarises the approach taken.

The focus of the consultation was to gather feedback on:

- How the options would impact travel behaviours and access to key locations;
- Perceived strengths and weaknesses of the options; and
- Concerns with any aspect of the options.

Table 19: Consulted Options

Initial Short List Option	Consulted Option
Initial Short List Option A 	**Consulted Option A** 
Initial Short List Option B 	
Initial Short List Option C 	**Consulted Option B** 
Initial Short List Option D 	**Consulted Option B Variation** 

Source: MM and NZTA

High-level diagrams of the options were produced for the consultation with no specific details shown for walking and cycling provision. The public were asked to provide feedback on their travel behaviours, so the location of crossings could be refined. Similarly, the public were asked to provide feedback on the type of solution they wanted to see implemented in the intersection of Sandspit Road / Matakana Road and the potential use of a new public space at the northern end of Elizabeth Street if the variation option would go ahead.

A total of 376 responses were received, submitted predominantly online, but a significant minority submitted using the hard copy form. In addition, submissions from three interest groups were received. A full report on the public consultation has been provided in **Appendix F.**

Analysis of the responses showed the following common themes:

- Option A (roundabout at the main Hill Street intersection, supported by a second roundabout at the Matakana Rd/Sandspit Rd intersection) received the greatest level of support. People felt that it would best support traffic volumes and flows, improve safety and reduce the complexity of the intersection.
- Option B (traffic signals at the main Hill Street and new connections at Bank Street) and B variation (similar to B with roundabout in the Matakana Rd / Sandspit Rd) were not well supported. There were concerns that these options would increase congestion, not address safety concerns, increase confusion and reduce accessibility to the town centre.
- A new roundabout had the greatest support for the improvement of the Matakana Rd/ Sandspit Rd intersection as it was believed this would best support traffic flows and intersection safety.
- A range of interim improvements were frequently suggested including pedestrian facilities, widening of the Shoesmith bridge and a left-turn slip lane from Sandspit Road to Elizabeth Street.
- The importance of improvements to the intersection being made and the urgency to complete such improvements was strongly emphasised across the majority of responses.

The feedback themes identified through this public consultation informed the design refinement and assessment of options to identify a preferred option.

Walking and Cycling

The Investment Logic Map for the project (see **Section 3.5**) identifies “a lack of safe and effective alternatives to private vehicle travel” within Warkworth. The benefits of resolving this problem include making walking and cycling viable options for local trips within and around Warkworth. Together, these statements feed into Investment Objective number 4: *Improve public transport, walking, and cycling choices for trips within Warkworth.* Consequently, all options developed for the project should support this objective.

At the long list phase of the project it was assumed that all options would provide dedicated facilities for people travelling by bike and or foot, and that adequate crossings will be provided. However, no design work or optioneering for these facilities was undertaken as part of the long list assessment. The Long List MCA considered the impacts of different intersection types and new connections when assessing their impacts on people travelling by bike or on foot.

During the short list refinement phase careful consideration was given to provision of adequate facilities to enable safe and effective alternatives to private car travel. Different options were considered to understand their feasibility and effectiveness in responding to the identified problems and achieving the desired outcomes. The principles, standards and guidelines followed to design for people travelling by bike and on foot are described in detailed in the Design Report (**Appendix G).** This includes a *Cycle Facility Options Assessment* Report documenting the decisions made for people travelling by bike.

Key decisions applied to the Final Short List were as follows:

- Safe and high quality, dedicated infrastructure has been identified as an effective way to increase the number and proportion of people travelling by bicycle in Warkworth and achieve Investment Objective Four.
- Off-road bi-directional cycle paths were identified as the preferred approach at the time of writing this business case.
- Signalised pedestrian and cycle crossings ("toucan" crossings) to be provided in the five arms of the Hill Street intersection.
- Provision of facilities along Sandspit Road have not been included as part of the improvements of this project. It is expected that the upgrade of the Sandspit Road corridor will occur with the urbanisation of Warkworth North East, in the third stage of development (post 2033).

Matakana Road / Sandspit Road Intersection

Following on from the refinement and public consultation detailed above, further modelling work was undertaken using AIMSUN in order to further refine the design of the short list options.

AIMSUN is a mesoscopic modelling tool that can provide forecasts for intersection performance, traffic delays and other metrics based on mid-level network layouts for design elements including intersections, lanes, links and crossing facilities. In particular, AIMSUN models interactions between adjacent intersections and roundabouts with signalised crossings to a generally accepted level of accuracy.

AIMSUN was used to test and optimise the design options, incorporating pedestrian and cycle crossings and to confirm the form of the Matakana Road / Sandspit Road intersection. AIMSUN testing demonstrated that overall performance of the Hill Street intersection was optimised for designs with a common approach at Hill Street and at Matakana Road / Sandspit Road i.e. either roundabouts at both or signals at both. The form of the Matakana Road / Sandspit Road intersection therefore was confirmed as a roundabout when a roundabout at Hill Street intersection was considered (Option A) and signals when a signalised intersection was considered at the Hill Street intersection (Option B). Performance was measured by forecast travel times for journeys at a 'High' priority within the Hill Street journey hierarchy (see **Section 6.5**).

AIMSUN modelling demonstrated that Option B variation (left turn only into Elizabeth Street and roundabout at Matakana Road / Sandspit Road intersection) performed poorly for all traffic, by comparison with both Option A and Option B. This is because the traffic re-routed to the Matakana Road / Sandspit Road roundabout would have a significant negative impact on the performance of that intersection and consequently, the network as a whole would be adversely impacted.

Taking also into account the lack of support for this variation during the public consultation, the Option B variation was not taken further forward from this stage and was not included in the final short list.

Further detail on the testing and assessment has been provided in the Modelling Technical Report in **Appendix E.**

6.5.1 Short List Refinement Summary

A summary of the design refinement decisions that lead to a final short list is provided in Table 20 below.

Table 20: Short List Refinement Summary

Design element	Refinements / Decisions
Access to Warkworth Town Centre via Elizabeth Street	Incorporation of an inbound link into Elizabeth Street to provide direct access to Warkworth Town Centre for vehicles travelling from the North and West. This is consistent with modelling results and removes barriers for the future development of a bus network in Warkworth. This is also in line with the public consultation responses that show a lack of support for restricted access into Elizabeth Street.
SH1 / Bank Street connection	Bank Street connection outbound only. This simplifies the overall layout of the intersection, reducing the space required for vehicles which in turn allows

Design element	Refinements / Decisions
	more space for people travelling by bikes and on foot. The only banned movement (SH1 into town centre) is a not a key movement to be provided at this location since there is an alternative access route via Whitaker Road.
Form of Matakana Road / Sandspit Road intersection	Performance optimised for designs with a common approach i.e. roundabout with roundabout and signals with signals.
Walking and cycling	Signal controlled “Toucan” crossings provided on all arms of the Hill St intersection. Off-road bi-directional cycle paths along SH1, Hill Street, Elizabeth Street and Matakana Road. Provision of facilities along Sandspit Road to be confirmed by SGP.

6.6 Final Short List

The final short list designs for Option A and Option B are shown in Figure 31 and Figure 32 below. A ‘Do Minimum’ option was also included for comparison in the Short List Assessment (Figure 30).

Do Minimum

The Do Minimum option only includes the following committed projects:

- Ara Tūhono - Pūhoi to Warkworth,
- Matakana Link Road; and
- Safety improvements at the Hill Street intersection originally programmed for late 2018 consisting of:
  - Signalised crossing across Sandspit Road;
  - Raised zebra table across the left slip lane from SH1 into Sandspit Road; and
  - Pedestrian path connecting to the existing car park.

Otherwise the layout of the intersection remains as existing.

Figure 30: Do Minimum layout

Option A

Option A is a five-arm roundabout at the main Hill Street intersection, and a three-arm roundabout at the Sandspit Rd / Matakana Rd intersection.

Figure 31: Option A layout

Key features of Option A are as follows:

- Oval five-arm dual-lane roundabout at the main Hill Street intersection.
- Three arm circular dual-lane roundabout at Sandspit Road / Matakana Road.
- Two approach lanes and one departure lane on most legs except on Sandspit Road (culvert) and Elizabeth Street.
- Protected bi-directional cycle path along SH1, Elizabeth Street, Sandspit Road (culvert), Hill Street and Matakana Road.
- Signalised “Toucan” crossings on each arm of the Hill Street intersection. Staggered crossing on Sandspit Rd (culvert). Toucan crossings are a type of pedestrian crossing that also allows bicycles to be ridden across.
- Shared paths where there are space constraints to provide continuity to the cycle paths.

Option B

Option B rationalises the existing traffic signals at Hill Street intersection by preventing access out of Elizabeth Street. The Sandspit Road / Matakana Road intersection which includes Millstream Place. is controlled by traffic signals, and Bank Street is extended to create a new link with SH1. The Bank Street connection is outbound only and controlled by traffic signals.

Figure 32: Option B layout

Key features of Option B are as follows:

- Four-arm signalised intersection at the main Hill Street intersection with an inbound link for access into Elizabeth Street.
- The Sandspit Road / Matakana Road intersection, which includes Millstream Place, is controlled by traffic signals.
- New connection of Bank Street with SH1 controlled by signals (left in / left out only) to allow exiting traffic from Elizabeth Street.
- Signal controlled “Toucan” crossings provided on all arms of the Hill Street intersection, with a raised zebra crossing on the slip lane from Sandspit Road (culvert).
- Protected bi-directional cycle path along SH1, Elizabeth Street, Sandspit Road (culvert), Hill Street and Matakana Road.
- A signal controlled “Toucan” crossing on the southern side of Bank Street across SH1.

6.7 Short List Assessment

Each of the Short List options was assessed using the MCA Framework outlined in **Section 4.3**. Following discussions with the SGA team, minor modifications to the scoring system were made to tailor the framework to the specifics of the Hill Street project. The MCA criteria remain the same as for the long list assessment. Individual criteria were assigned to subject matter specialists, including Mana Whenua, to assign ratings.

Non-scored criteria were taken into account for the short list assessment as follows:

- **Stakeholder Feedback:** stakeholder feedback for each option identifying scale / validity of objections, identified preference / proposed changes to options etc. Feedback provided by other key partners / stakeholders.
- **Policy Analysis:** alignment with the strategic policy framework including the AUP, Auckland Plan with particular consideration to provisions that derive from section 6 of the RMA. Ensure the strategic framework assessment does not consider detailed issues raised in the effects criteria.
- **Value for Money:** the indicative BCR as summarised in **Section 6.7.1**; and
- **Resilience:** this was not expected to be a differentiator for the short list options as the resilience risks are tied to the location, which is fixed for all options**.**

6.7.1 MCA Supporting Information

To inform the short list assessment, the short-listed designs were reviewed to compare their:

- Operational Performance – tested in AIMSUN and SATURN;
- Costing – high-level estimate of delivery cost; and
- Value for Money – high-level indicative estimate for the Benefit Cost Ratio (BCR) of each design.

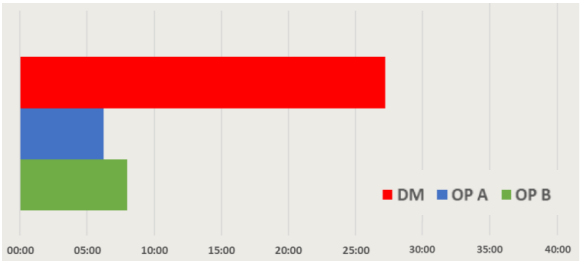
Operational Performance

Operational performance was tested in the AIMSUN model, measured by forecast travel times for journeys at a 'High' priority within the Hill Street journey hierarchy (see **Section 6.5**), comprising the following:

- Matakana Road to/from Town Centre;
- Sandspit Road to/from Town Centre;
- Hill Street to/from Town Centre; and
- SH1 North to/from Town Centre.

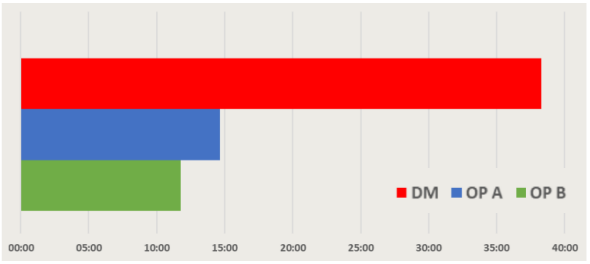
Travel times for each option below are summarised.

Figure 33: AM Travel Time to Town Centre



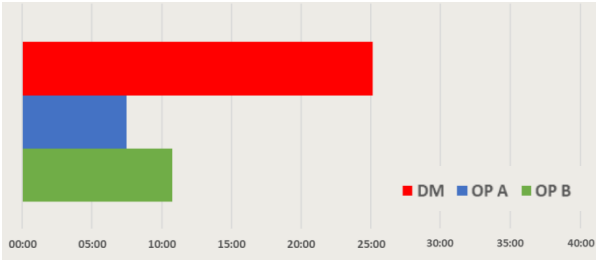
Source: AIMSUN

Figure 34: PM Travel Time to Town Centre



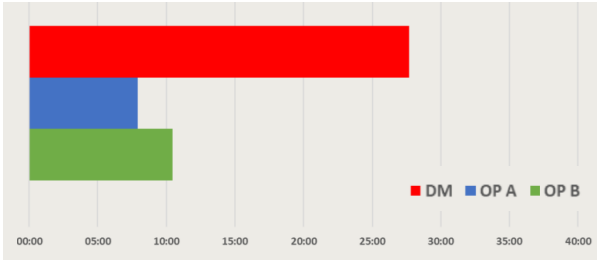
Source: AIMSUN

Figure 35: AM Travel Time from Town Centre



Source: AIMSUN

Figure 36: PM Travel Time from Town Centre



Source: AIMSUN

The travel time analysis demonstrated that Option A is forecast to deliver the lowest travel times for High priority journeys overall during the AM Peak and leaving the Town Centre in the PM Peak. Option B is expected to provide the lowest travel times toward the Town Centre in the PM Peak. Both options offer significant journey time savings when compared with the Do Minimum design.

Additional analysis was carried out using SATURN to understand the sensitivity of the travel time benefits to the provision of upgrades on the wide Warkworth network (SGA investigations). Two scenarios were modelled:

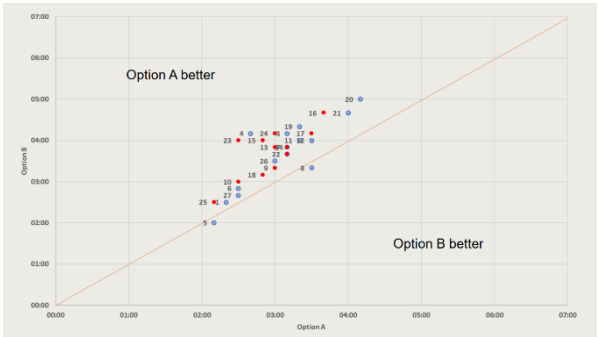
- Do Minimum scenario (minimum level of investment), which includes only committed projects:
  - Puhoi to Warkworth; and
  - Matakana Link Road;
- SGA scenario (maximum level of investment), which includes all of the above, plus:
  - Full Western Collector;
  - Sandspit Link; and
  - Southern Interchange.

Travel times for 27 different journeys through the intersection during the PM Peak were analysed for Option A and Option B under the two scenarios. Red dots show journeys defined as high priority; these are compared in Figure 37 and Figure 38.

Figure 37: 2036 PM Peak Do Minimum Travel Time Comparison

Source: P2T SATURN Model

Figure 38: 2036 PM Peak SGA Travel Time Comparison



Source: P2T SATURN Model

The comparison shows that when considering only the committed projects in the wider network (Do Minimum scenario), both options provide broadly similar travel times overall, with the number of journeys for which Option A is better being comparable to the number of journeys for which Option B is better. Under the SGA scenario however, Option A is better than or similar to Option B for almost all of the journeys reviewed.

These results have been interpreted with some degree of caution, as limitations when modelling Option A in SATURN means that the model is likely to be underestimating delays at the roundabouts to a limited extent. However, this analysis is considered sufficient to show that at lower traffic volumes (traffic has alternative routes via other links in the SGA network), Option A provides the lowest travel times for journeys travelling through the Hill Street Intersection.

Further detail on the testing and assessment has been provided in the Modelling Technical Report in **Appendix E**.

Costing

Mott MacDonald prepared a high-level cost estimate for Option A and Option B (the cost for the Do Minimum option is expected to be comparatively minor at less than $1 million). Further details are available in **Appendix H** and the estimate is summarised in Table 21.

Table 21: Cost Estimates Summary

Item	Description	Option A – Roundabouts	Option B – Signalised
A	Net Project Property Costs	$336,000	$336,000
B	Project Development Phase	Nil	Nil
C	Pre-implementation Phase	$525,000	$525,000
D	Implementation Phase	$6,442,600	$8,215,700
	Implementation Fees	$162,000	$162,000
	Physical Works Costs	$6,280,600	$8,053,700
E	Project Base Estimate (A+C+D)	$7,303,600	$9,076,700
F	Contingency	$1,146,700	$1,503,500
G	Project Expected Estimate (E+F)	$8,450,300	$10,580,200
H	Funding Risk Contingency (10%*E)	$730,400	$907,700
I	**95th percentile Project Estimate (G+H)**	**$9,181,000**	**$11,488,000**

The 95th percentile Project Estimate for Option A is $9,181,000 and for Option B, $11,488,000, the difference in estimated cost being driven by the greater physical works cost for implementing the signalised intersection design due to the greater extent of works involved (upgraded link and new connection of Bank Street with SH1).

Value for Money

A high-level economic evaluation was carried out for both options under both investments scenarios described above, following guidance in the NZTA Economic Evaluation Manual (EEM). This compared the estimated costs (capital cost estimated above and maintenance costs) with the forecast benefits, comprising:

- Travel time savings;
- Vehicle operating cost (VOC) savings;
- Reduction in CO_2 emissions;
- Benefits of cycling and walking, and
- Accident cost savings.

All costs and benefits were assessed using net present value (discount rate of 6%). BCRs were calculated, but due to the incomplete development of the designs and modelling, only indicative BCRs were reported on at this stage – see Table 22 below.

Table 22: Indicative BCRs

Design	Wider Network Scenario	
	Do Minimum	SGA
Option A	Very High	High
Option B	Very High	Low

Source: Mott MacDonald

It can be seen that both designs are forecast to achieve BCRs that are Very High under the Do Minimum scenario, reducing to High for Option A and Low for Option B under the SGA scenario (due to wider network upgrades in the SGA scenario having already provided some of the forecast benefits).

6.7.2 MCA Assessment

A short list assessment workshop was held on 13th March 2019 with project stakeholders and partners to review the scoring, gather feedback and identify an emerging preferred option. The Workshop 5 memo (Short List Options Assessment) is provided in **Appendix C.**

A challenge session was consequently held with AT technical specialists to understand the rationale behind the scores and refine scoring. The outcome of the challenge session is also included in **Appendix C.**

The full MCA assessment table including rationale for scoring can be found in **Appendix C,** with the final MCA evaluations are summarised in Table 23 below.

Table 23: Short List MCA Scoring

ID	Well-Being	Topic	DM	Option A	Option B
IO1	Economic	Journey time	-3	1	2
IO2	Economic	Capacity	-4	2	2
IO3	Cultural, Social, Economic	Accessibility	-3	1	3
IO4	Social, Environmental	Travel choice	1	2	3
1a	Cultural	Heritage	0	-1	-1
2a		Mana Whenua Customary Practice	0	2	1
2b		Māori communities and wellbeing	0	2	2
2c		Māori land	0	1	1
2d		Te Taiao (Air, Land, Water, Taonga)	-1	2	1
3a		Accessibility	0	1	1
3b		Treaty Redress	0	-3	-3
3c		Implementation of the Te Aranga design principles	-1	2	1
3d		Employment and Community	-1	1	1
3e		Culture and traditions	-1	2	1
3f		Environment	-1	2	1
4a	Social	Land use futures	0	2	3
4b		Urban design	0	2	1
4c		Land requirement	0	-2	-3
4d		Social cohesion	1	3	3
4e		Human Health and Wellbeing	0	0	-2
5a		Social Equitability	0	0	0
6a	Environmental	Landscape / visual	0	-2	-3
6b		Stormwater	0	1	1

ID	Well-Being	Topic	DM	Option A	Option B
6c		Ecology	0	-1	-1
7a		Climate Change outcomes	0	1	1
7b		Ecological Opportunities	0	1	1
8a	Economic	Transport system integration	-1	2	3
8b.1		Safety for Vehicles	-1	3	2
8b.2		Safety for Pedestrians	1	3	3
8b.3		Safety for Cyclists	0	3	3
9a		Construction impacts on utilities / infrastructure	0	-3	-3
9b		Construction Disruption	0	-3	-3
10a		Construction costs / risk / value capture	0	-2	-3
10b		Maintenance costs	0	-1	-1
10c		Operational costs	-1	1	-2
11a		Behavioural Change / Future Technology Opportunities	0	2	2
12a		Housing and future development	0	0	0
12b		Existing economic opportunities	0	0	0

The key differentiators (criteria with a score difference of two or more) between Option A and Option B were as follows:

- **IO3 Accessibility:**
  - Option A (+1) - Average travel times increase by no more than 3 minutes between 2026 and 2036. Pedestrian and cyclist travel time remains similar for key movements throughout the day due to signalised crossings.
  - Option B (+3) - Average travel times increase by no more than 30 seconds between 2026 and 2036. Pedestrian and cyclist travel time remains similar for key movements throughout the day due to signalised crossings.
- **4e Human health and wellbeing:**
  - Option A (0) - Provided that the roundabout on Sandspit and Matakana Road does not bring traffic closer to the house on the corner of Millstream Place, then there is no increase in noise impact. The installation of a roundabout at SH1 is unlikely to have any effects on sensitive land uses nearby.
  - Option B (-2) - This will have an adverse effect on the residents on Falls Street and Bank Street as this option creates a new through traffic route from Elizabeth Street through to SH1. A number of sensitive land uses are located in this area (Police Station, kindergarten, Lodge, etc)
- **10c Operational Costs:**
  - Option A (1) – Option A has potential for reducing operational costs since only on demand signalised crossings will be needed, compared to one existing signalised intersection.
  - Option B (-2) – Option requires greater operational costs than the existing condition since three fully signalised intersections are required.

To identify the emerging preferred option, the project team ranked the options from 1 to 3 within each wellbeing (descending order). This was a qualitative assessment, rather than totalling the individual scores the positives and negatives of the options were balanced against each other. This step provided the relative performance of each option against the four well-beings. The final rankings are summarised in Table 24.

Table 24: Short List MCA Summary

	Do Minimum	Option A	Option B
Well-Being Ranking			
Cultural	3rd	1st	2nd
Social	2nd	1st	1st
Environment	3rd	1st	1st
Economic	3rd	1st	1st

Source: Mott MacDonald

The MCA clearly demonstrates that the Do Minimum option provides inferior outcomes overall than either Option A or Option B, as it ranks the lowest against all well-beings. The analysis of the scorings of the MCA showed that Option A ranks highest against all the well-beings, followed very closely by Option B which only scores lower than Option A in the Cultural well-being.

A more detailed examination of the MCA scoring reveals that for the cultural wellbeing, Option A scored just one point higher than Option B, which is not considered to provide sufficient certainty that Option A is the optimal solution.

Overall, the result of the assessment showed little differentiation between the shortlisted options. Therefore, further engagement was undertaken with stakeholders in order to identify points of differentiation that would reveal a single preferred option. Members of the Project Control Group (PCG) recommended a that a Safe Systems Assessment be undertaken. Further work on the cost estimates was also carried out to ensure that these were robust, and an assessment of the risks and opportunities associated with each option was made. The results are documented in **Appendix H** and summarised in the following section.

6.7.3 Post-MCA Analysis

Safe System Review

A high-level review of both options based on a Safe System approach was undertaken. This is documented in **Appendix H** with key findings summarised as follows:

- Option A and Option B have some distinct safety risk characteristics.
  - Roundabouts experience generally fewer and lower severity injury crashes, compared with signalised intersections. This is due to there being fewer conflict points and a lower relative speed environment.
  - However, roundabouts do experience a higher proportion of crashes involving cyclists, compared with signalised intersections. This is due to the higher reliance on drivers' observation and judgement of when to give way and how much clearance to leave when passing cyclists.
- Both options provide high-quality off-road facilities for cyclists that are expected to attract most of the cyclists using the Intersection.
- There are design refinements and measures available that can mitigate and reduce the risks associated with both options, and the risks for vulnerable road users in particular. Post-mitigation, Option A is considered to provide the safest solution overall.

Cost Estimation

An independent review of the cost estimates was undertaken by AT to ensure robustness of the figures. The focus of the review was on the rates used, the contingencies applied, and the set of assumptions made. The main outcome of the review was the increase of the contingencies applied given the very preliminary nature of the options at this stage of the project. As a result of the increase in contingencies, the cost estimate figures have increased considerably, and this is shown in Table 25.

Table 25: Updated Cost Estimates Summary

Item	Option A		Option B	
	Before Review	After Review	Before Review	After Review
Physical Works	$6,280,600	$6,509,092	$8,053,700	$8,694,582
Project Expected Estimate	$8,450,300	$11,862,820	$10,580,200	$15,845,875
95th Percentile Project Estimate	**$9,181,000**	**$15,297,398**	**$11,488,000**	**$20,448,214**

Value for Money

Following the cost estimate review, the benefit / cost analysis that formed part of the MCA assessment was updated and the results are documented in **Appendix H** and shown in Table 26.

Table 26: Indicative BCRs

Design	Wider Network Scenario	
	Do Minimum	SGA
Option A	Very High	High
Option B	Very High	Low

Source: Mott MacDonald

Risks and Opportunities

A review of the risks and opportunities during planning, construction and operation of each option was carried out. Full tables are provided in **Appendix H** with the key risks and opportunities identified, summarised below.

Option A

- Risks:
  - Uncertainty over alignment with SGA plans. The SGA ITA specifies a philosophy for selecting intersection types where roundabouts are located at the outer extents of the Structure Plan area (to serve as a rural/urban threshold and control vehicle speeds) and traffic signals are provided at the inner intersections (to provide greater amenity for pedestrians and cyclists)
  - Dual roundabouts can be intimidating for people on bikes;
  - Grading issues at the Matakana Road / Sandspit Road intersection likely to require structure widening / construction;
  - Cross-section at Sandspit Road will require widening of the culvert; and
  - Limited ability to control flows at peak times.
- Opportunities:
  - Option is scalable, and construction could be staged; and
  - Signalised crossings could be used for roundabout metering.

Option B

- Risks:
  - Third party Road Controlling Authority approval for additional road access to SH1 from the extension of Bank Street through to the SH1
  - Opposition for removal of parking along Fall Street (reputational risks);
  - Low community support (reputational risks that community was not listened to during consultation);
  - Potentially poor alignment with future bus network;
  - New connection requires new retaining walls and potential impacts on surrounding properties; and
  - Cross-section at Sandspit Road will require widening of the culvert.

- Opportunities:
  - Increased movement along Fall Street and Bank Street could help activate the area;
  - New connection can reduce SH1 severance effects; and
  - Movement restrictions offer the opportunity to simplify movements, reduce vehicle flows and reallocate space at the Hill Street intersection.

6.8 Recommended Option

An assessment has been made, taking into account the results of the Short List MCA and the supporting analysis. It was noted that:

- Option A is considered to provide a safer solution overall, subject to implementation of design refinements and mitigation measures to ensure that desired safety outcomes are achieved.
- Option A provides a good level of service for customers until flows approach capacity, Option B manages congestion better.
- Option A ranks slightly higher than Option B in the MCA Assessment.
- Option A has greater potential to deliver value for money than Option B.

This assessment shows that Option A is likely to perform better than Option B in respect of safety, the four well-beings and value for money, whilst also being able to provide the expected benefits. Consequently, the recommendation is to proceed with Option A to the next stage of development, as the Recommended Option.

It is recommended that the delivery of the cycling facilities proposed by this project is staged to align with the delivery of cycle facilities along the connecting corridors as part of the SGP network.

Part C – Recommended Option

7 Recommended Project Option Scope

The design for the Recommended Option was further refined to provide a concept design level of detail, which is summarised in this chapter. The design provides two roundabouts and high-quality walking and cycling facilities, including signalised crossings. It is anticipated that additional enabling design elements including retaining structures and cut and fill batters will be required for construction.

The scope of the project is to reconstruct the Hill Street Intersection to provide a double roundabout in the Hill Street / SH1/ Sandspit Road / Elizabeth Street Intersection, a double roundabout at the Sandspit Road / Matakana Road intersection, a priority T-intersection to access the Kowhai Park car park from SH1 and a protected left in / left out access Millstream Place from Sandspit Road. High quality walking and cycling facilities, including toucan crossings are also to be provided.

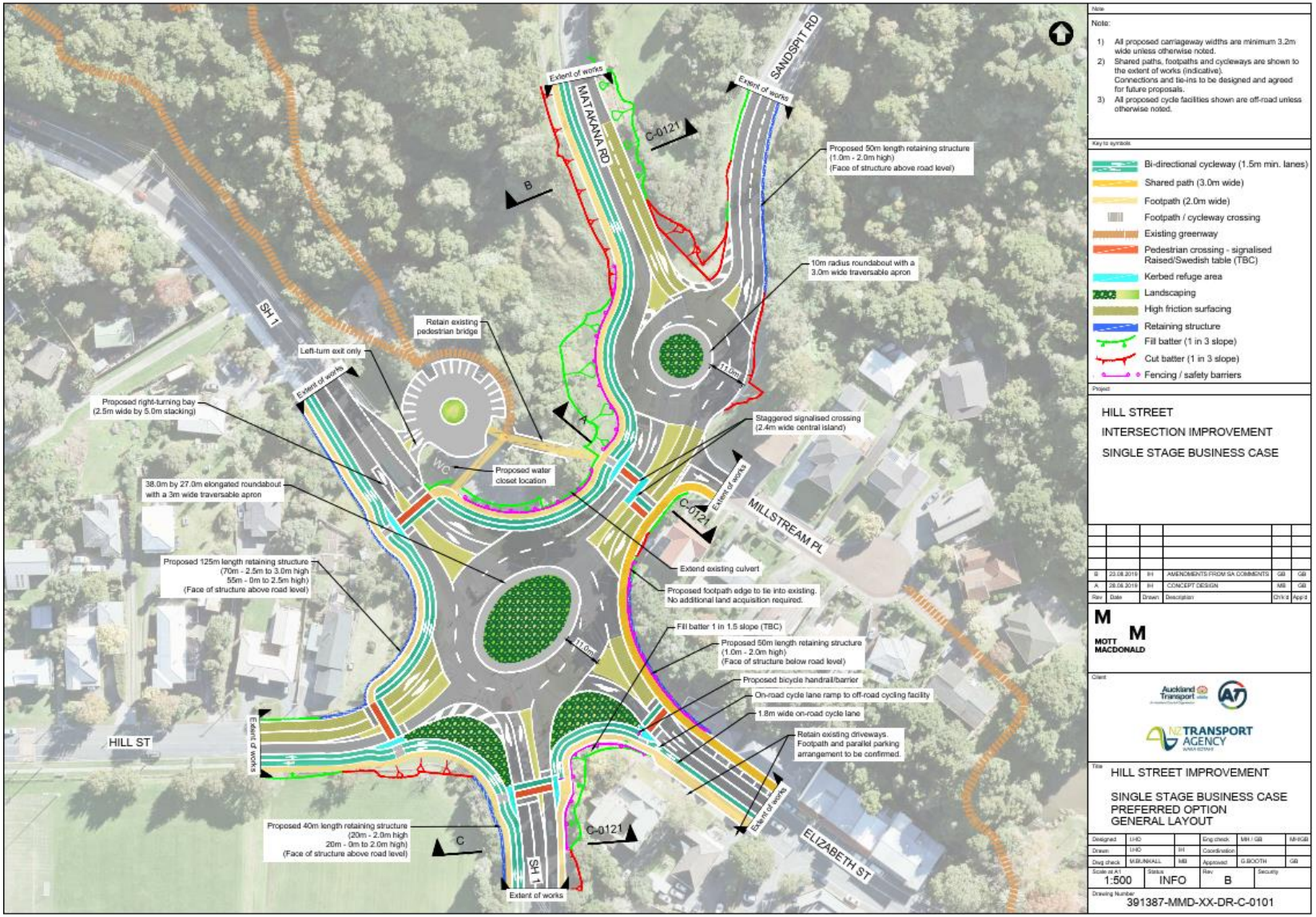
The location of the project in Warkworth is shown in Figure 39.

Figure 39: Project Location

Source: Mott MacDonald

Figure 40 below shows the extent of the project works. A full set of drawings for the Recommended Option are provided in **Appendix I**.

Figure 40: Overview of Project Works



Source: Mott MacDonald

The following sections describe in more detail each component of the design for the Recommended Option. These have been designed to a concept level at this stage.

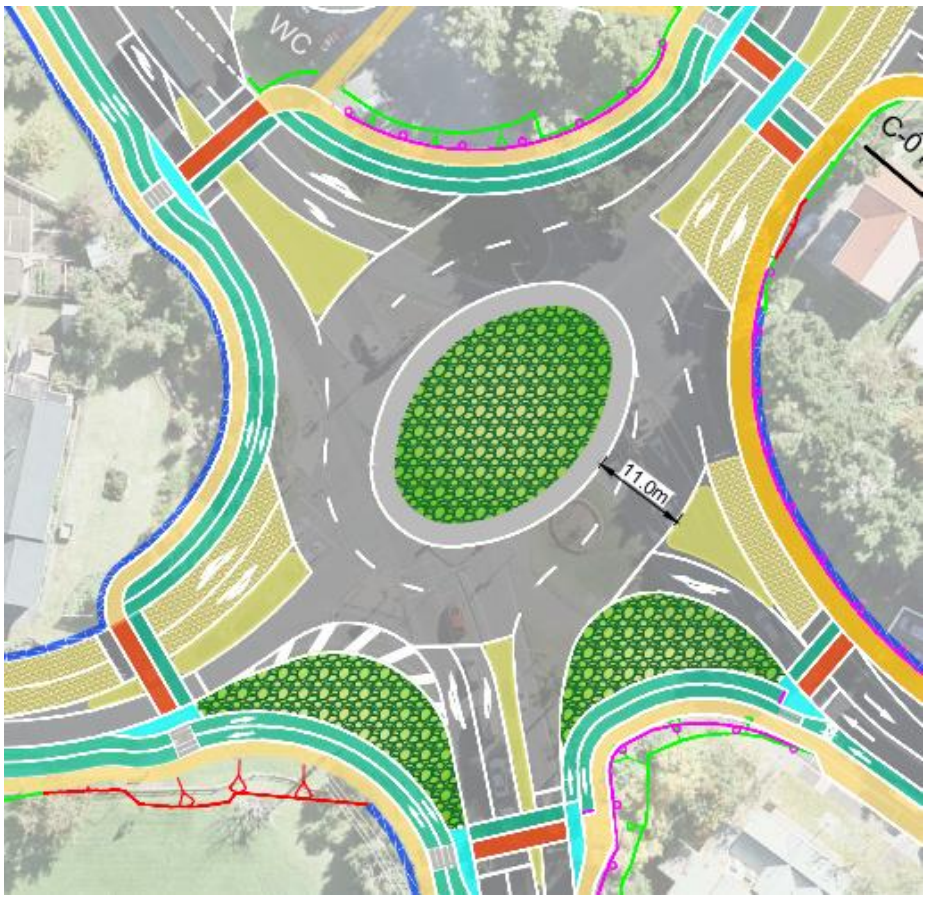
7.1 Hill Street / SH1 / Sandspit Road / Elizabeth Street

- 38.0m by 27.0m oval roundabout with a 3.0m traversable apron and potential for planting and public art;
- Two circulating traffic lanes, totalling 11.0m across;
- Roundabout with five arms:
  - SH1 (North):
    - One entry lane for left turn and through movements;
    - One entry lane for right turn movements;
    - One exit lane designed for access from the outer circulation lane only.
  - Sandspit Road:
    - One entry lane for left turn and through movements and paved with high-friction surfacing;
    - One entry lane for right turn movements and paved with high-friction surfacing; and
    - Two exit lanes.
  - Elizabeth Street:
    - One entry lane for all movements; and
    - One exit lane designed for access from the outer circulation lane only and paved with high-friction surfacing.
  - SH1 (South):
    - One entry lane for all movements;
    - One entry lane for right turn movements; and
    - One flared exit lane.
  - Hill Street:
    - One entry lane for left turn and through movements and paved with high-friction surfacing;
    - One entry lane for through and right turn movements and paved with high-friction surfacing; and
    - One flared exit lane.
- All roundabout arms provide a raised island dividing entry lanes from exit lanes.
- Turn radius between SH1 (South) and Hill Street reduced by painted hatching to manage movements and speeds.
- Walking and cycling facilities provided off-street between all arms:
  - Bi-directional cycleway (1.5m minimum wide in each direction) separated from carriageway by a buffer 0.5m wide (minimum) and a footpath (1.8m wide) separated by the cycleway by a buffer 0.3m wide:
    - SH1 (North) to Sandspit Road, design includes fencing along northern side to mitigate the risk of falling due to level difference;
    - SH1 (South) to Hill Street;
    - Hill Street to SH1 (North); and
    - Elizabeth Street to SH1 (South), design includes fencing along southern side to mitigate the risk of falling due to level difference.
  - Shared path (3.0m wide) adjacent to carriageway:
    - Sandspit Road to Elizabeth Street, design includes fencing along eastern side to mitigate the risk of falling due to level difference.
- The following enabling infrastructure is expected to be required:

- Retaining structures to be provided along outer boundary of the design:
  - Between Hill Street and SH1 (North) (125m in length, up to 3.0m in height); and
  - Between Sandspit Road and Elizabeth Street (50m in length, up to 2.0m in height).
- Fill batters to be provided along outer boundary of the design:
  - Between SH1 (North) and Sandspit Road; and
  - Between Elizabeth Street and SH1 (South).
- Existing Culvert on Sandspit Road to be widened on both sides
- Cut batters to be provided along outer boundary of the design:
  - Between SH1 (South) and Hill Street.

The general layout for the Hill Street / SH1 / Sandspit Road / Elizabeth Street roundabout intersection is shown in Figure 41.

Figure 41: Hill Street / SH1 / Sandspit Road / Elizabeth Street Design



Source: Mott MacDonald

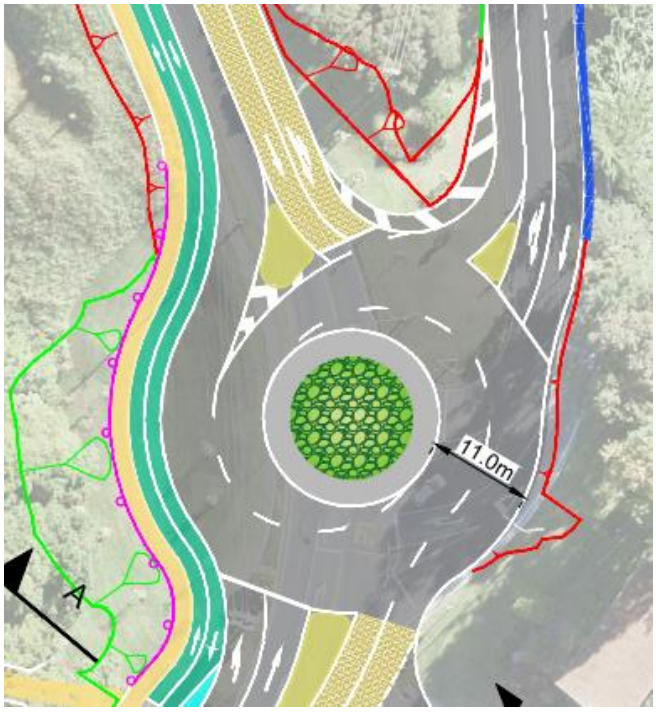
7.2 Sandspit Road / Matakana Road

- 10.0m radius roundabout with a 3.0m traversable apron and potential for planting;
- Two circulating traffic lanes with spiral markings, totalling 11.0m across;
- Roundabout with three arms:
  - Matakana Road:
    - One entry lane for left turn and through movements and paved with high-friction surfacing;
    - One entry lane for through movements and paved with high-friction surfacing; and
    - One exit lane designed for access from the outer circulation lane only.

  - Sandspit Road (North):
    - One entry lane for through movements;
    - One entry lane for right turn movements; and
    - One exit lane designed for access from the outer circulation lane only.
  - Sandspit Road (South):
    - One entry lane for left turn movements;
    - One entry lane for through movements; and
    - Two exit lanes paved with high-friction surfacing.
- All roundabout arms provide a raised island dividing entry lanes from exit lanes.
- Turn radius between Matakana Road and Sandspit Road (North) reduced by painted hatching to manage movements and speeds.
- Spiral markings to guide vehicle movements.
- Landscaping areas in the corners of SH1 (South) with Elizabeth Street and Hill Street.
- Walking and cycling facilities provided off-street along the western edge, between Sandspit Road (South) and Matakana Road:
    - Bi-directional cycleway (1.5m minimum wide in each direction) separated from carriageway by a buffer 0.5m wide (minimum) and a footpath (1.8m wide) separated by the cycleway by a buffer 0.3m wide.
- The following enabling infrastructure is expected to be required:
  - Fill batters to be provided along outer boundary of the design:
    - Between Sandspit Road (South) and Matakana Road.
  - Cut batters to be provided along outer boundary of the design:
    - Between Matakana Road and Sandspit Road (North); and
    - Between Sandspit Road (North) and Sandspit Road (South).

The general layout for the Sandspit Road / Matakana Road roundabout intersection is shown in Figure 42.

Figure 42: Sandspit Road / Matakana Road Design



Source: Mott MacDonald

7.3 Elizabeth Street

- One traffic lane in each direction provided;
- On-street parallel parking provided along the northern side of carriageway;
- On-street parallel parking along the southern side of carriageway is to be confirmed in the next design phase;
- Walking and cycling facilities provided along both sides:
  - 3.0m wide shared path along northern side of carriageway, design includes fencing along northern side to mitigate the risk of falling due to level difference;
  - 1.8m wide on-street cycleway on southern side of carriageway, transitioning to a bi-directional cycleway (1.8m wide in each direction);
  - 2.0m wide footpath along southern side of carriageway; and
  - Signalised 'toucan' crossing for people walking and cycling to cross between northern and southern sides of the carriageway, waiting refuge area and high friction surfacing provided on approach from roundabout to mitigate potential risk of accidental red-light running.
- The following enabling infrastructure is expected to be required:
  - Retaining structure to be provided along part of the northern boundary of the design;
  - Fill batter to be provided along part of the southern boundary of the design.

The general layout for Elizabeth Street is shown in Figure 43.

Figure 43: Elizabeth Street and SH1 South Design

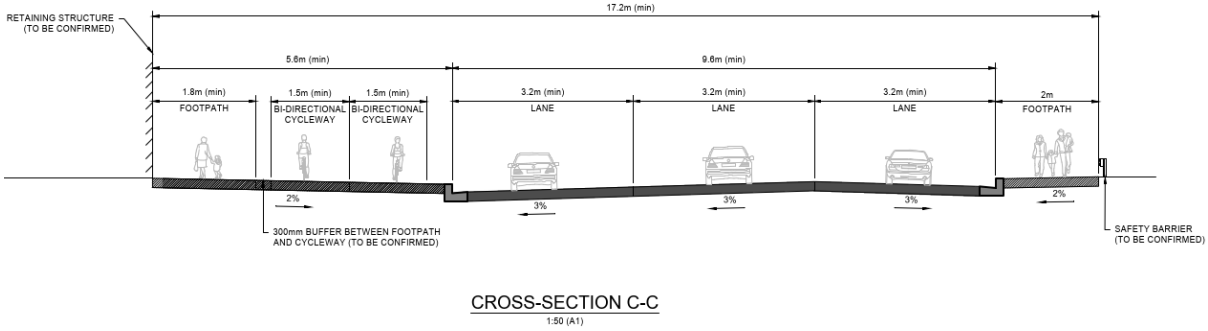
Source: Mott MacDonald

7.4 SH1 (South Arm)

- Two northbound traffic lanes and one southbound traffic lane provided;
- Walking and cycling facilities provided along western side:
  - Bi-directional cycleway (1.5m minimum wide in each direction) separated from carriageway by a buffer 0.5m wide (minimum) and a footpath (1.8m wide) separated by the cycleway by a buffer 0.3m wide; and
  - Signalised 'toucan' crossing for people walking and cycling to cross between western and eastern sides (connecting to Elizabeth Street using facilities described in **Section 7.1**) of the carriageway, kerbed refuge areas provided at both ends of the crossing to mitigate potential risk of conflict between people walking and people cycling.
- The following enabling infrastructure is expected to be required:
  - Retaining structure to be provided along part of the western boundary of the design;
  - Fill and cut batters to be provided along parts of the eastern boundary of the design.

The indicative cross section for the southern arm of SH1 is shown in Figure 44 and the general layout in Figure 43 above.

Figure 44: SH1 (South) Cross Section



Source: Mott MacDonald

7.5 Hill Street

- Two eastbound traffic lanes and one westbound traffic lane provided;
- Walking and cycling facilities provided along southern side:
  - Bi-directional cycleway (1.5m minimum wide in each direction) separated from carriageway by a buffer 0.5m wide (minimum) and a footpath (1.8m wide) separated by the cycleway by a buffer 0.3m wide; and
  - Signalised 'toucan' crossing for people walking and cycling to cross between southern and northern (connecting to SH1 (North) using facilities described in **Section 7.1**) sides of the carriageway, kerbed refuge areas provided at the southern end of the crossing to mitigate potential risk of conflict between people walking and people cycling and high friction surfacing provided on approach for eastbound traffic to mitigate potential risk of accidental red-light running.
- The following enabling infrastructure is expected to be required:
  - Retaining structure to be provided along part of the northern boundary of the design;
  - Fill and cut batters to be provided along parts of the southern boundary of the design.

The general layout for Hill Street is shown in Figure 45.

Figure 45: Hill Street Design

Source: Mott MacDonald

7.6 SH1 (North Arm)

- One northbound traffic lane and one southbound traffic lane (widening to two lanes on approach to the intersection) provided;
- Proposed right-turn bay (2.5m wide by 5.0m stacking) for northbound traffic turning into the relocated Kowhai Park carpark.
- Walking and cycling facilities provided along western side:
  - Bi-directional cycleway (1.5m minimum wide in each direction) separated from carriageway by a buffer 0.5m wide (minimum) and a footpath (1.8m wide) separated by the cycleway by a buffer 0.3m wide; and
  - Signalised 'toucan' crossing for people walking and cycling to cross between the western and eastern (connecting to Sandspit Road using facilities described in **Section 7.1**) sides of the carriageway, kerbed refuge areas provided at the western end of the crossing to mitigate potential risk of conflict between people walking and people cycling.
- The following enabling infrastructure is expected to be required:
  - Retaining structure to be provided along the western boundary of the design.

The general layout for the northern arm of SH1 is shown in Figure 46.

Figure 46: SH1 (North) Design

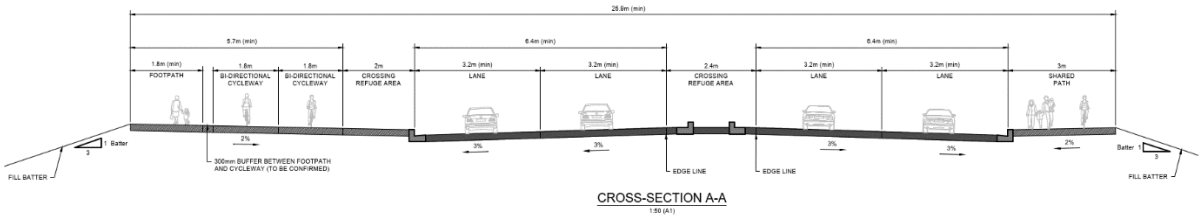
Source: Mott MacDonald

7.7 Sandspit Road (South Arm) and Sandspit Road / Millstream Place

- Two northbound traffic lanes and two southbound traffic lanes provided;
- Millstream Place to meet Sandspit Road at a priority T-intersection, restricted to left-in left-out only (one traffic lane for each on Millstream Place), enforced by central median between northbound and southbound traffic lanes.
- Walking and cycling facilities provided along both sides:
  - Bi-directional cycleway adjacent separated from carriageway and footpath separated from the cycleway, design includes fencing along western side to mitigate the risk of falling due to level difference;
  - 3.0m wide shared path along eastern side of carriageway connecting into Millstream Place, and
  - Staggered signalised 'toucan' crossing for people walking and cycling to cross between the western and eastern sides of the carriageway via a 2.4m wide central island. Kerbed refuge areas provided at the western end of the crossing to mitigate potential risk of conflict between people walking and people cycling and high friction surfacing provided on approach for southbound traffic to mitigate potential risk of accidental red-light running.
- The following enabling infrastructure is expected to be required:
  - Widening of the existing Sandspit Road culvert;
  - Fill batter to be provided along the western boundary of the design; and
  - Fill and cut batters to be provided along parts of the eastern boundary of the design.

The indicative cross section for the southern arm of Sandspit Road is shown in Figure 47 and the general layout in Figure 48.

Figure 47: Sandspit Road (South) Cross Section



Source: Mott MacDonald

Figure 48: Sandspit Road (South) and Sandpit Road / Mill Stream Place Design

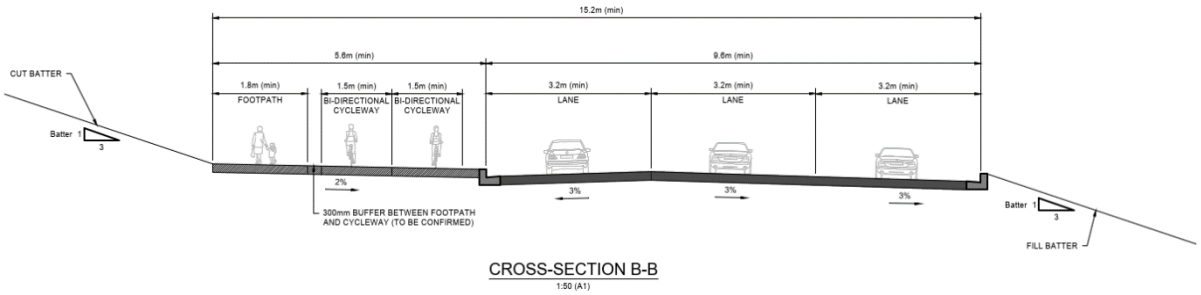
Source: Mott MacDonald

7.8 Matakana Road

- One northbound traffic lane and two southbound traffic lanes provided (narrowing to one lane north of the intersection with Sandspit Road);
- Walking and cycling facilities provided along western side:
- The following enabling infrastructure is expected to be required:
  - Cut batters to be provided along the western boundary of the design; and
  - Both cut and fill batters to be provided along parts of the eastern boundary of the design.

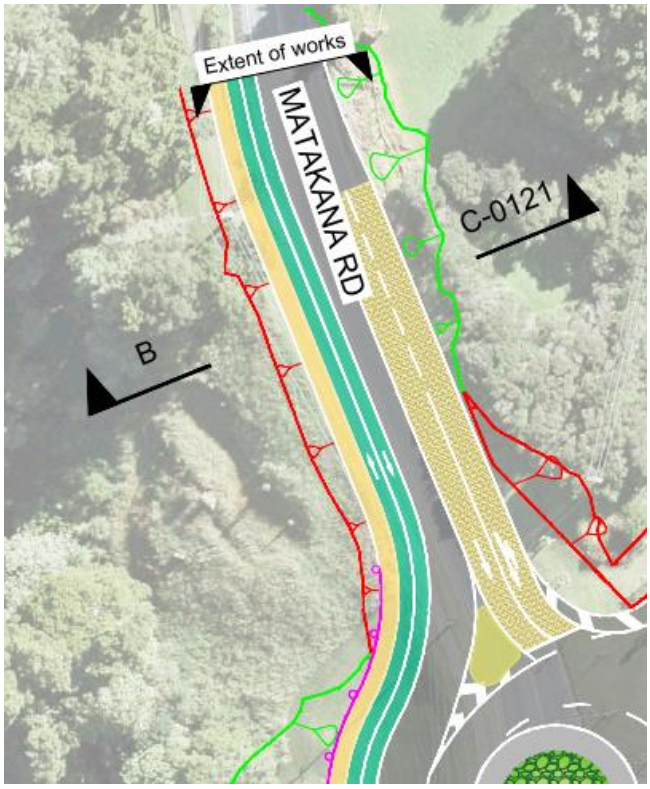
The indicative cross-section for Matakana Road is shown in Figure 49 and the general layout in Figure 50.

Figure 49: Matakana Road Cross-Section



Source: Mott MacDonald

Figure 50: Matakana Road Design



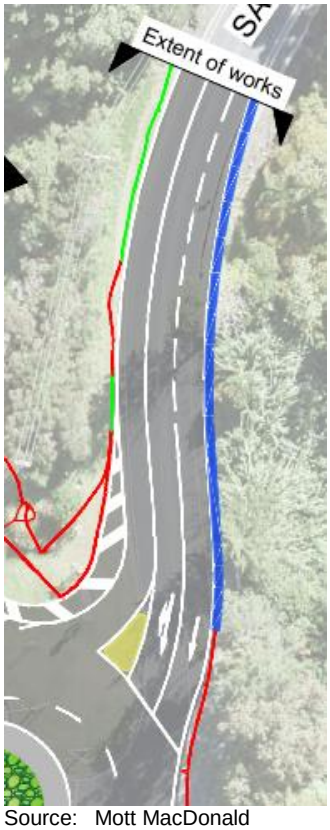
Source: Mott MacDonald

7.9 Sandspit Road (North Arm)

- One northbound traffic lane and two southbound traffic lanes provided (narrowing to one lane north of the intersection with Matakana Road);
- The following enabling infrastructure is expected to be required:
  - Retaining structure to be provided along the eastern boundary of the design; and
  - Both cut and fill batters to be provided along parts of the western boundary of the design.

The general layout for the northern arm of Sandspit Road is shown in Figure 51.

Figure 51: Sandspit Road (North Arm) Design



Source: Mott MacDonald

7.10 Kowhai Park Carpark

- Relocate the car park access from Sandspit Road to SH1;
- Access to be provided via a priority T-intersection providing one entry lane (left and right in) and one exit lane (left out only);
- Reconfigure the car to provide approximately 16 spaces, arranged for perpendicular parking around the car park edge.
- Walking facilities to be provided from the carpark towards Sandspit Road (connecting with crossing facility and with existing greenway) via existing pedestrian bridge and towards SH1 (connecting with crossing facility).
- Desirable for the existing public toilet block to be retained by detailed design for the fill battering required to enable the construction of the Hill Street / SH1 / Sandspit Road / Elizabeth Street roundabout intersection.

The general layout for the Kowhai Park carpark is shown in Figure 52.

Figure 52: Kowhai Park Carpark Design

Source: Mott MacDonald

7.11 Other Work

Other works in the scope of the detailed design and implementation include:

- Contract management, including the management of traffic, health and safety, environment and quality;
- Stakeholder liaison;
- Survey and set-out works;
- Site clearance, earthworks and site preparation;
- Installation of streetlights;
- Stormwater infrastructure;
- Road pavement construction;
- Signs and road markings;
- Tree and vegetation pruning or removal; and
- Landscaping and planting works.

8 Recommended Option Assessment

The Recommended Option has been assessed further to identify expected impacts and any issues for implementation.

The assessment confirms that the Recommended Option will provide capacity to allow additional urban growth to be delivered whilst maintaining access to employment and core services and making walking, cycling and public transport viable choices.

Wider project impacts are expected to include reductions in emissions from enabling mode choice, reducing rat-running and facilitating development of employment and services locally. Positive social impacts will include enabling improvements to health from increased active travel, as well as better access to facilities and development supporting a stronger local economy. There is potential for some negative outcomes resulting from the increase in footprint, but it is anticipated that these can be mitigated and that the net impacts will be positive.

Implementation of the Recommended Option will require some additional land to be acquired, although the impact on private land is expected to be reduced during detailed design. Issues relating to constructability, operability, statutory requirements and asset management will be investigated further at the detailed design stage, but preliminary assessments for the SSBC have found no critical flaws.

This section assesses the performance of the Recommended Option against four key criteria:

- The project outcomes;
- Implementability;
- Wider project impacts; and
- Do-Minimum option.

8.1 Outcomes

This section explains how the Recommended Option for the Hill Street Intersection Improvements will deliver each of the three identified project benefits and includes an assessment against the investment objectives.

8.1.1 Benefit One – Residential and Economic Growth

The Recommended Option is expected to increase the capacity of the Hill Street Intersection, which will enable a larger volume of peak people movements to be accommodated at the Intersection and, by virtue of the Intersection's function as a focal point, within the Warkworth network. This will enable the Warkworth network to carry many of the additional generated trips associated with the Auckland Unitary Plan's growth aspirations for the town and in turn, this will allow investment in housing and employment in and around Warkworth.

The design will also facilitate movements by walking, bike and public transport, enabling trips by these modes to and from the growth areas to be provided for, subject to the provision of the wider SGP network. Provision for these modes is discussed further in **Section 8.1.3**.

The Recommended Option aligns with the Warkworth Structure Plan by providing the necessary transport infrastructure to support the growth and development of Warkworth. By enabling development, the Recommended Option contributes to increasing housing stock and employment land to accommodate the anticipated growth of population and jobs in Warkworth. This has the potential to attract people and jobs to support the economic growth of Warkworth and the wider area.

8.1.2 Benefit Two – Accessibility to employment, education, tourism and core services

The Recommended Option will enable all of the movements identified in the Warkworth network journey hierarchy. The majority of these movements will be direct to facilitate ease of access and wayfinding for all modes.

Direct vehicle access will be provided to / from all arms of the Intersection, with the single exception of Millstream Place, which will be limited to left-in and left-out. However, the use of roundabout intersections will limit the indirectness of routeing required for access to or from this street. The increase in Intersection capacity will enable an acceptable Level of Service to be provided for the high, medium and low priority movements within the hierarchy under forecast typical peak demand levels. This will limit the magnitude of delays experienced by these movements and will therefore provide reasonable journey times for access to the employment, education, tourism and core services in and around Warkworth.

The Intersection design will also facilitate through access by walking, cycling and public transport. Separate or shared walking and cycling facilities will be provided along all arms, on both sides where space is not constrained. Signalised crossing facilities will also be provided across all arms, located to facilitate direct access by people walking and cycling. The directness of access for general traffic movements will not prevent access by bus routes and the geometric design allows for bus movements. Provision for these modes is discussed further in **Section 8.1.3**.

8.1.3 Benefit Three – Public transport, walking and cycling are viable choices for trips within Warkworth

The Recommended Option has been designed to fully accommodate access by people walking, cycling or on public transport.

Cycling facilities will be provided on SH1, Hill Street, Matakana Road and Elizabeth Street, segregated from vehicle traffic and either alongside or sharing space with foot traffic when space is constrained. Signalised crossing facilities will also be provided across all arms, located to facilitate direct access by people walking and cycling, closely aligned with desire lines. These facilities will tie in with existing active travel infrastructure, as well as allowing for connection with emerging SGP proposals for walking and cycling networks.

The scope for public transport access will be good, with direct access towards key public transport attractors such as the Town Centre retained and road geometric design allowing for bus movements. Bus passengers will also benefit from the limitation of delays discussed in **Section 8.1.2**.

8.1.4 Assessment Against Investment Objectives and KPI's

Table 27 provide specific evidence of how the Recommended Option performs against the investment objectives and associated KPI's. It also sets out a potential monitoring regime to assess the benefits of the project. It is anticipated that this will be refined in the pre-implementation stages prior completing statutory approvals.

Table 27: Assessment against Investment Objectives and KPI's

<table>
<tr><th>Investment Objective</th><th>KPI</th><th>Expected Outcome / Assessment</th><th>Potential Monitoring Regime</th></tr>
<tr><td colspan="4">Benefit: Residential and economic growth</td></tr>
<tr><td>Support residential and economic growth by increasing journey time reliability</td><td>KPI 1.1: Increased reliability</td><td>Travel time reliability was measured from AIMSUN model outputs by dividing the 85th percentile of the forecast travel times by the mean travel times. For simplification, journeys considered 'high' priority within the Hill Street journey hierarchy to and from town centre were aggregated to derive a single average figure for reliability at 2026. The results from AIMSUN summarised in Table 28 below show a significant improvement in travel time reliability of the Recommended Option when compared to the Do Minimum. Improvements are particularly evident in the PM period, with changes from over seven minutes in Do Minimum to just over one minute on the Recommended Option.
Pedestrians' and cyclists' travel time are expected to remain similar for key movements throughout the day due to the provision of on-demand signalised crossings and segregated facilities.

Table 28: Average journey time reliability for key trips to / from town centre at 2026
<table><tr><th rowspan="2">85th percentile travel time / mean travel time (mm:ss)</th><th colspan="2">Do-Min</th><th colspan="2">Preferred Option</th></tr><tr><th>AM</th><th>PM</th><th>AM</th><th>PM</th></tr><tr><td>02:23</td><td>07:20</td><td>00:35</td><td>01:09</td></tr></table>Source: AIMSUN model outputs</td><td>Pre and post - implementation journey time data collection</td></tr>
<tr><td>Enable land to be developed in line with the FULSS by ensuring there is sufficient capacity at the Hill Street intersection to support development</td><td>KPI 1.2: Land developed in lines with FULSS</td><td>This KPI is measured by ensuring there is enough capacity and acceptable level of service in the network to accommodate the anticipated key journeys associated with growth of population and jobs in Warkworth. SATURN modelling outputs were analysed to assess level of service at the intersection in future years during the PM period. Two future level of investment scenarios are considered: DM - minimum level in the network / only committed projects; and SGA - maximum level of investment in the network. SATURN outputs summarised in Table 29 below show a much-improved level of service provided by the Recommended Option when compared with the Do Minimum option. Walking and cycling facilities, prioritised through on demand signalised crossing points and segregated facilities provide additional capacity to support development demand

Table 29: intersections Level of Service Comparison
<table><tr><th rowspan="2">Intersection</th><th colspan="2">2026 – PM</th><th colspan="2">2036 - PM</th></tr><tr><th>DM</th><th>SGA</th><th>DM</th><th>SGA</th></tr><tr><td colspan="5">Do-Minimum Option</td></tr><tr><td>Hill Street / SH1</td><td>E</td><td>D</td><td>F+</td><td>F+</td></tr><tr><td>Sandspit / Matakana</td><td>C</td><td>A</td><td>F</td><td>D</td></tr><tr><td colspan="5">Preferred Option</td></tr><tr><td>Hill Street / SH1</td><td>B</td><td>B</td><td>E</td><td>B</td></tr><tr><td>Sandspit / Matakana</td><td>B</td><td>B</td><td>E</td><td>B</td></tr></table>Source: SATURN model outputs</td><td>Pre and post - implementation journey time data collection

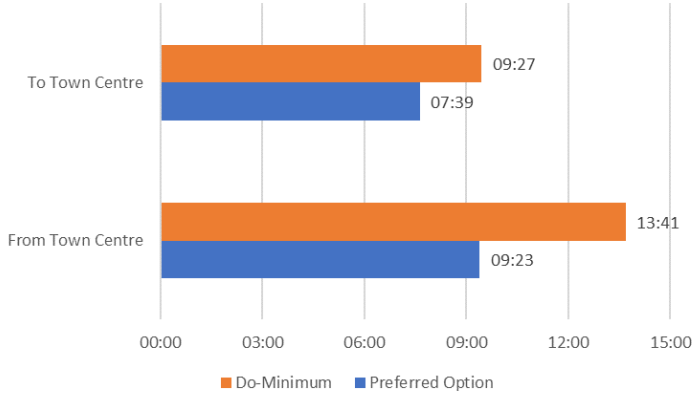
Number of new housing units in the new urban areas

Square meters of new business development on defined business sites in the surrounding areas.</td></tr>
</table>

<table>
<tr><th>Investment Objective</th><th>KPI</th><th>Expected Outcome / Assessment</th><th>Potential Monitoring Regime</th></tr>
<tr><td></td><td>KPI 1.3: Increased throughput</td><td>This KPI is measured by the forecast demand flows travelling through the intersection extracted from SATURN model. Results for the PM period, summarised in Table 30, show a considerable increased in the number of vehicles per hour that the Recommended Option can cater for when compared with the Do-Minimum option for the various years and scenarios considered. Biggest increases in throughput occurs in the Hill Street / SH1 intersection.
It is expected that the installation of the walking and cycling facilities will attract 10 new pedestrian trips and 40 cycling trips per day in the first year, which will subsequently grow at 3% annually.

Table 30: Demand Flows Comparison (vehs/hr)
<table><tr><th rowspan="3">Intersection</th><th colspan="6">2026 - PM</th></tr><tr><th colspan="2">Do-Minimum Option</th><th colspan="2">Preferred Option</th><th colspan="2">Change</th></tr><tr><th>DM</th><th>SGA</th><th>DM</th><th>SGA</th><th>DM</th><th>SGA</th></tr><tr><td>Hill Street / SH1</td><td>2,790</td><td>2,160</td><td>3,790</td><td>2,960</td><td>36%</td><td>37%</td></tr><tr><td>Sandspit / Matakana</td><td>2,310</td><td>1,760</td><td>2,440</td><td>2,080</td><td>6%</td><td>18%</td></tr><tr><th colspan="7">2036 - PM</th></tr><tr><td>Hill Street / SH1</td><td>2,830</td><td>2,360</td><td>4,910</td><td>4,330</td><td>73%</td><td>83%</td></tr><tr><td>Sandspit / Matakana</td><td>2,960</td><td>2,750</td><td>3,190</td><td>3,220</td><td>8%</td><td>17%</td></tr></table>Source: SATURN model outputs</td><td>Pre and post - implementation traffic counts

Pre and post - implementation pedestrian and cycle counts</td></tr>
<tr><td colspan="4">Benefit: Accessibility to employment, education, tourism and core services</td></tr>
<tr><td rowspan="2">Ensure accessibility to employment, education, tourism and core services in, and around, Warkworth by maintaining journey times for local trips as close as possible to 2022 levels (after construction of Matakana Link Road and with future</td><td>KPI 2.1: Maintain access</td><td>The Recommended Option will enable all of the movements identified in the Hill Street intersection journey hierarchy. The majority of these movements will be direct to facilitate ease of access and wayfinding for all modes. The magnitude of delays experienced by these movements will be minimised and will therefore provide reasonable journey times for access to the employment, education, tourism and core services in and around Warkworth.
The scope for public transport access will be good, with direct access towards key public transport attractors such as the Town Centre retained and road geometric design allowing for bus movements.
The Intersection design will also facilitate through access by walking and cycling with separate or shared walking and cycling facilities provided along all arms.</td><td>Pre and post - implementation journey time data collection</td></tr>
<tr><td>KPI 2.2: Travel times maintained</td><td>This KPI was measured by comparing the forecast travel times of the Recommended Option against the Do-Minimum option from AIMSUN model outputs at 2026. For simplification, journeys considered ‘high’ priority within the Hill Street journey hierarchy to and from town centre were aggregated to derive a single travel time figure at 2026. The results for the PM period, summarised in Figure 53, show improvements in travel times of almost two minutes for journeys toward the Town Centre and over four minutes for trips exiting Town Centre.</td><td></td></tr>
</table>

Investment Objective	KPI	Expected Outcome / Assessment	Potential Monitoring Regime
infrastructure elsewhere responding to growth)		**Figure 53: Forecast Travel Time Comparison of key trips to / from town centre at 2026 - PM period**  Source: AIMSUN model	
Benefit: Public transport, walking and cycling are viable choices for trips within Warkworth			
Improve public transport, walking and cycling choices for trips within Warkworth	KPI 3.1: Increase throughput	It is expected that the installation of the walking and cycling facilities will contribute to increase level of cycling and walking in the area. An assumption was made that the new facilities of the Recommended Option will attract 10 new pedestrian trips and 40 cycling trips per day in the first year, which will subsequently grow at 3% annually.	Pre and post - implementation pedestrian and cycle counts
	KPI 3.2: Physical health support	The Intersection design will facilitate through access by walking, cycling and public transport contributing towards a mode shift away from private vehicle use. Expected benefits associated with this are: – Healthier communities by encouraging of less sedentary lifestyles and reducing the burden on local health services; – Contribution to meeting air quality targets.	

8.2 Implementability

8.2.1 Constructability

Each stage of the development and analysis of options that resulted in the identification of the Recommended Option considered constructability issues at a high level, particularly with respect to footprint, watercourses, grading and geotechnical issues.

Design considerations for the proposed intersection upgrade will involve widening and re-grading the existing pavement beyond the current road corridor. Earthworks (cuts and fills), retaining walls and culvert widening on Sandspit Road will be required as part of associated works. A Preliminary Geotechnical Appraisal has been undertaken as part of this study and the outcomes are included in the Design Report that can be found in **Appendix G**. The key geotechnical engineering constraints for the Recommended Option are summarised in Table 31.

Table 31: Key Geotechnical Constraints

Locations	Pavement Widening	Earthworks	Retaining Walls
Hill Street	Requires cut-backs to the existing slopes	Moderate	55m long, up to 2.5m height
Elizabeth Street	Not required	Minor	50m long, up to 2.0m height
Sandspit Road	Requires cut-backs to the existing slopes, Culvert widening required	Minor	50m long, up to 2.0m height
Matakana Road	Requires cut-backs to the existing slopes	Significant	60m long, up to 2.5m height
State Highway 1	Requires cut-backs to the existing slopes	Moderate	70m long, up to 3.0m height in the northern arm 40m long, up to 2.0m height in the southern arm

8.2.2 Statutory Requirements

A range of statutory approvals will be required for the construction and operation of the Recommended Option. When deciding how best to consent a project best practice will be to prepare a Consenting Strategy to determine the most appropriate consenting pathway. Broadly a Consenting Strategy will consider the following matters:

- size, scale, complexity of the project,
- the zoning of the land,
- earlier work and design requirements,
- requirement for private land,
- programme for construction; and
- public perception of the project.

Projects which have a level of complexity or public interest and require the acquisition of land are often consented by way of a Notice of Requirement to designate the land. Given AT is a Requiring Authority it has the powers to designate land for the proposes of transport. This may be the appropriate pathway for this project. Overall the Consenting Strategy will determine the approach and the detail of the statutory approvals likely to be required dependent on the design, construction methodology and operational requirements. The benefit of a new designation will enable to project to respond to all of these phases underpinned by appropriate baseline

conditions which set the parameters for construction and operation in regard to managing the effects generated by the project. The aim is to retain flexibility to respond to design refinements and construction requirements coupled with maximising the best value for money and managing risk.

It is acknowledged that an existing designation (6763) for SH1 / Great North Road applies to SH1 under NZTA as the Requiring Authority. There are no conditions attached to the designation. It is understood that at some point the state highway classification status will be revoked by NZTA and the road transferred to AT. The existing designation can be transferred as part of this process from one Requiring Authority to another however at this stage the timing of the revocation is uncertain.

Should AT prepare a new NoR for the works it can overlay the NoR over the existing NZTA designation however in this case the existing designation has priority. In addition, AT would also need to obtain approval/consent from the NZTA under section 176 of the RMA. Consent can only be refused on the basis that the new activity would prevent or hinder the works that are authorised by the earlier designation. Given they are both for roading purposes it is unlikely approval/consent would be withheld.

While a designation provides for land use under the Auckland Unitary Plan (AUP), additional resource consents are still required under AUP or works pursuant to section 9, 14 and 15 of the RMA. The regional consents anticipated for this project may include:

- Earthworks. AUP Chapter E26 (Infrastructure) is likely to be the most applicable chapter and under E26.5.3.1 (A97) [DP] and E26.6.3.1 (A117) [RP], earthworks for greater than 2500m^2 for all roads and zones and SEA is Restricted Discretionary. AUP (Chapters E11 and E12) identifies that the required earthworks for the Recommended Option will lie within zones and overlays categorised as Residential, Open Space, SEA-T and Other Roads and Zones. The most restrictive categories are Residential and Open Space, which specifies that earthworks over 500m^3 are Restricted Discretionary [DP]. Land disturbance on a SEA overlay greater than 5m^3 is also Restricted Discretionary [RP]. The estimated Recommended Option earthworks total 3,300m^3 of cut and 5,500m^3 of fill and more than 5m^3 of fill will fall within the SEA overlay so resource consent is required. The proximity of the earthworks to the stream may require erosion and sediment controls during construction to avoid or minimise adverse effects on the watercourse.
- Stormwater discharges – AUP identifies that for High Use Roads, redevelopment of an existing road is Permitted up to a surface area of 5,000m^2. The estimated impervious surface area created by the Recommended Option is greater than 5,000m^2, so resource consent may be required.
- Lakes, rivers, streams and wetlands - Bed disturbance, or depositing any substances, reclamation, diversion of water and incidental temporary damming of water associated with the construction and operation of the culvert over the stream in the SEA will require consent. A new culvert in a SEA which is less than 30m is a discretionary activity (E3.4.1 A32) while a culvert which is more than 30m is a non-complying activity (E3.4.1 A33). The classification under these rules of the addition of 12m of culvert to the existing 47m length culvert is not explicitly clear as such it would require further discussion with Council to understand what they determine will trigger the activity status. In the next phase, a full Assessment of Environmental Effects (AEE) will be required for consenting purposes, this will include an ecological assessment of the area affected by the culvert widening over the stream. Additionally, the AUP objectives and policies with regard to this potentially non-complying activity would need to be fully assessed (i.e. gateway test) to determine if the construction and design of a new culvert would have no more than minor effects on

the environment and/or meet the objectives and policies in the AUP. Further engagement with Auckland Council, Mana Whenua and other key stakeholders could facilitate this assessment.

Other legislation which may impact on the delivery of the project include:

- **Public Works Act 1981** – outlines the process and requirements for the acquisition of land by a requiring authority and the provision of compensation. While the legislation is available to allow for compulsory acquisition, it is AT's preference to engage and negotiate with landowners early to come to a mutually agreeable settlement. Discussion with NZTA's property team will need to occur as well.
- **Reserve Act 1977** – Approval will be required under the Reserve Act 1977 for land take involving reserves. This process is independent of resource consent and designation procedures and may involve public notification. The Shoesmith Reserve and the Kowhai Park are guided by reserve management plans. There are several options under the Public Works Act to transfer the use of the reserve land between government departments without acquiring the land. Transfer under sections 50 and 52 of the Public Works Act may not be subject to public notification. This is a matter that needs to be addressed as part of a property acquisition strategy.

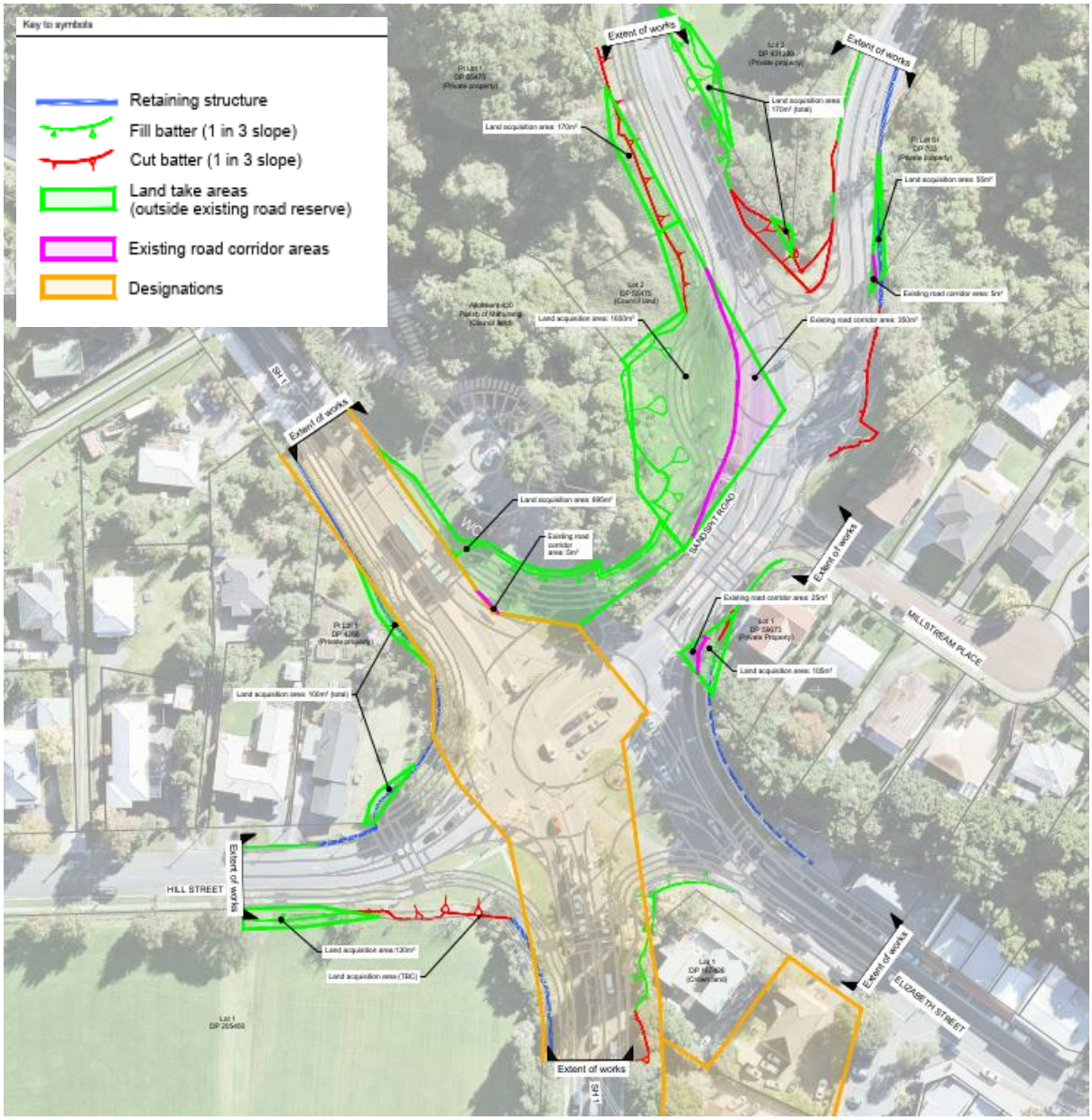
8.2.3 Property Impacts

The delivery of the Recommended Option is likely to require the partial acquisition of five private properties and three sections of public land. It may be possible that the Recommended Option design could be further refined in the next phase of design to minimise the effect on private property.

The risks generally associated with property acquisition have been identified as relevant to this project, including the potential for time delays and additional costs relating to negotiation. The expected timeframe for a willing sale is around six months, which could extend to around nine months if landowners wish to negotiate. The timeframes for acquiring reserve land will also need to be considered.

A land requirement plan is included in the Recommended Option Drawings on **Appendix I** and this is also shown in Figure 54.

Figure 54: Recommended Option Land Requirements



Source: Mott MacDonald

A summary of the Recommended Option land requirements by property is shown in Table 32. The expected costs of the total land requirements as included in the cost estimate is approximately $1.2M (as at June 2019). This assumes only costs of public owned land using prices provided by AT for mixed urban areas of brownfield.

Table 32: Recommended Option Land Requirements by Property

Address	Owner-ship	Zone	Land-take area (m^2)	Area within existing road corridor (m^2)	Land required (m^2)	Notes
Pt Lot 1 DP 55475	Private	Residential – Large Lot Zone	170	0	170	Likely to be required
Lot 2 DP 431389	Private	Future Urban Zone	170	0	170	Likely to be required
Pt Lot 51 DP 703	Private	Future Urban Zone	55	5	50	Likely to be required
Lot 2 DP 55475	Public	Open Space – Informal Recreation Zone	1,650	350	1,300	May be reduced if retaining walls are considered
Allotment 430 Parish of Mahurangi	Public	Open Space – Informal Recreation Zone	695	5	690	Relocation of car park entrance and WC area can be enhanced after construction.
Lot 1 DP 59673	Private	Residential – Single House Zone	105	25	80	May be avoided
Lot 1 DP 205450	Public	Open Space – Sport and Active Recreation Zone	130	0	130	Likely to be required
PT Lot 1 DP 4266	Private	Residential – Single house Zone	100	0	100	May be avoided
				Approximate Total Land Requirement	**2,690**	
				Total Private Owned Land	**570**	
				Total Public Owned Land	**2,120**	

8.2.4 Asset Management

The Recommended Option will require the standard maintenance necessary for the upkeep of AT's intersections. Features requiring additional maintenance include the following:

- Barriers/fencing;
- Planted roundabout islands;
- Toucan crossings;
- Street lighting;
- Retaining walls; and
- Culvert widening.

The expected maintenance costs have been divided into two categories, annual maintenance tasks and periodic costs.

The total annual maintenance task costs for the Recommended Option are estimated to be $196,798. This is the Net Present Value over the life of the project.

Periodic maintenance tasks are performed at specified times / frequencies throughout the life of the project. The maintenance tasks include work done every 5 years and 10 years. The total cost of periodic maintenance in present values for the Recommended Option is estimated to be $473,520 (Net Present Value).

8.3 Wider Project Impacts

8.3.1 Environmental Impact

The selection and development of the Recommended Option has taken environmental impacts into account at each stage, from the identification of ecological constraints when confirming the Initial Long List, through to the inclusion of criteria under the Environmental well-being within the MCAs for the Long and Short Lists.

A range of environmental impacts have been identified through the optioneering work at a high-level through the MCAs and provided in **Appendix C**. During the next phases of the project including design refinement and consenting an Assessment of Environmental Effects (AEE) will be completed to assess the environmental impacts in greater detail and develop the appropriate mitigations.

8.3.2 Social Impact

The selection and development of the Recommended Option has taken social impacts into account at the key stages, specifically the inclusion of criteria under the Social well-being within the MCAs for the Long and Short Lists.

The following social impacts have been identified for the Recommended Option:

- Modal choice will be supported, enabling travel by sustainable modes – walking, cycling and public transport, and thereby increasing travellers' activity levels, physical and mental health;
- The development of Warkworth as a Satellite Town will be supported, enabling provision of a compact urban form and local provision of employment and services, with consequent benefits for local opportunities, social cohesion and provision of housing;
- Overall access to the Town Centre and local reserves will be enhanced for walking, cycling and cars and access via public transport will be enabled;
- Opportunities to improve the urban form through landscaping and planting at the Intersection and Elizabeth Street;
- Some requirement for public reserve and private land – it is anticipated that additional reserve land will be provided in the local area to ensure no net loss of amenity; and
- No significant impacts on local heritage assets or their settings.

It is expected that any adverse social impacts will be outweighed by the overall positive impacts of the project.

8.3.3 Joint working

Inputs from partner organisations and stakeholders has been important in developing and refining the Preferred Option as described in **Section 2.** It is anticipated that there will be opportunities for further joint working with stakeholders to obtain value for money and to deliver the best outcomes.

In particular:

- NZTA: to revoke the existing state highway status of the section of SH1 between Puhoi to Warkworth.

- AC: to improve the urban form along Elizabeth Street and to optimise the interface between reserve land and the road reserve;
- Mana Whenua: to optimise the outcomes from planting, the culvert widening and the parking and driveway access into the courthouse;
- SGA: to integrate with SGA transport network proposals as they develop further; and
- Utility providers: to explore opportunities to coordinate utility works with this project and to minimise disruption.

8.4 Do-Minimum Option

The Do Minimum option includes committed interventions within the project study area plus projects in the wider network that affect the performance and operation of this project.

For the Short List assessment phase of the project, two Do Minimum scenarios were considered for the wider network. One Do Minimum scenario (DM) assumed only committed projects by 2036, which excluded all SGA projects. This is conservative, because it is likely that some of the SGA projects will be implemented by 2036 to support development. The other Do Minimum scenario (SGA) assumed that all the SGA projects will be constructed by 2036, which is also unlikely. This resulted in a wide range of BCRs.

For the Recommended Option phase, a Refined Do Minimum scenario was defined by including in the SGA scenario the infrastructure likely to be delivered at each year (2026 and 2036) in accordance with the SGA draft ITA. This Refined Do Minimum scenario was then compared against the Recommended Option for the economic evaluation.

The Modelling Technical Report included in **Appendix E** provides further details of these assumptions.

The Refined Do Minimum scenario includes the following projects at various years:

- Ara Tūhono - Pūhoi to Warkworth;
- Matakana Link Road;
- Western Collector;
- Southern Interchange;
- Land development based on the I11.4 land-use scenario; and
- Safety improvements at the Hill Street intersection (originally programmed for late 2018) consisting of:
  - Signalised crossing across Sandspit Road;
  - Raised zebra table across the left slip lane from SH1 into Sandspit Road; and
  - Pedestrian path connecting to the existing car park.

Otherwise the layout of the intersection remains as existing.

9 Recommended Option – Economic Analysis

An economic assessment was undertaken based on methodologies outlined in the Economic Evaluation Manual (EEM). The project delivery costs have been compared against the forecast benefits, which are principally travel time savings, but also active travel benefits and reductions in emissions, vehicle operating costs and crashes.

Cost benefit analysis shows the overall benefit cost ratio (BCR) to be 9.1. Further analysis has been undertaken to understand the sensitivity of this value to variations in cost and benefit values, as well as discounting and network assumptions. This analysis shows that overall sensitivity is low for reductions in BCR, but that the proposed provision of an alternative link between Matakana Road and Sandspit Road could materially affect the BCR, reducing it to 3.1. For robustness, a BCR of between 9.1 and 3.1 has been considered based.

The assessment profile against the latest NZTA Investment Assessment Framework (IAF) has been developed. It is considered that the Recommended Option scores a 'High' results alignment due to its importance to agreed land-use and multi-modal transport plans. Consequently, its prioritisation within the IAF is between 3 and 4 (out of 8).

9.1 Economic Summary of Recommended Project Option

To quantify the economic benefits of the Recommended Option, an economic assessment was undertaken based on methodologies outlined in the Economic Evaluation Manual (EEM). The transport model in the area (P2T SATURN model) was used to estimate the network impact for the assessment. Full details of the analysis are documented in **Appendix K**.

Table 33 presents a summary of the cost estimate for the Recommended Option, as detailed in **Section 10.1** below.

Table 33: Recommended Option Cost Estimate

Description	Cost
Total physical works	$8,433,000
Investigation / Design / Construction / Mitigation	$2,150,400
Project Property Costs	$1,187,200
Contingency Allowance	$3,435,890
Total expected estimate	$15,206,490
Funding Risk Contingency	$3,175,000
95th percentile Project Estimate	**$18,381,500**

Annual user benefits were estimated to include the following items:

- Travel time savings;
- Vehicle operating cost (VOC) savings;
- Reduction in CO_2 emissions;
- Benefits of cycling and walking, and
- Crash cost savings.

Table 34 presents the net present value for cost and benefit estimates for the Recommended Option. It is calculated using a discount factor of 6% over a 40-year evaluation period as per EEM. The net present values are in 2018 dollars. The Do Minimum baseline is as defined in **Section 8.4**, which also provides the wider network for the assessment of the Recommended Option. No assessment of Wider Economic Benefits has been undertaken for this analysis, so the assessed benefits may be understated.

Table 34: Economic Summary Table

Timing

Earliest implementation start date (assumed)	1 July 2024
Expected duration of implementation	12 months

Economic efficiency

Time zero	1 July 2018
Base date for costs and benefits	1 July 2018
Present value of total project cost of do minimum	$ 0.56m
Present value net total project cost of recommended option	$ 15.02m
Present value net benefit of recommended option (exc. WEBs)	$ 130.52m
BCR (exc. WEBs)	9.1
First year rate of return (FYRR)	10%

P50 costs

	Undiscounted Costs		**Present value**	
	Do Minimum	**Recommended Option**	**Do Minimum**	**Recommended Option**
Construction/ implementation	$ 0.00m	$ 8.43m	$ 0.00m	$ 7.96m
Investigation / Design / Construction / Mitigation	$ 0.00m	$ 2.15m	$ 0.00m	$ 2.03m
Property	$ 0.00m	$ 1.19m	$ 0.00m	$ 1.12m
Total implementation cost	$ 0.00m	$ 11.77m	$ 0.00m	$ 11.10m
Maintenance	$ 0.41m	$ 0.50m	$ 0.16m	$ 0.20m
Renewal	$ 1.47m	$ 1.80m	$ 0.40m	$ 0.47m
Project contingency	$ 0.00m	$ 3.44m	$ 0.00m	$ 3.24m
Total P50 project costs	**$ 1.88m**	**$ 17.51m**	**$ 0.56m**	**$ 15.02m**

Benefits

	Present Value of Operating Costs		**Present Value of Benefits**	
	Do Minimum	**Recommended Option**		**Recommended Option**
Travel time savings	$ 4,558.78m	$ 4,432.91m		$ 125.86m
Vehicle operating cost savings	$ 601.31m	$ 598.98m		$ 3.33m
Accident cost savings	$ 3.30m	$ 2.83m		$ 0.48m
Vehicle emissions reductions	$ 24.05m	$ 23.92m		$ 0.13m

Timing			
Walking and cycling (EEM v2)	$ 0.00m	$ -0.71m	$ 0.71m
PV total	**$ 5,187.44m**	**$ 5,056.92m**	**$ 130.52m**

Table 34 shows that the forecast BCR for the Recommended Option is 9.1 and the First Year rate of Return is 10%.

9.2 Sensitivity Analysis

In order to assess the robustness of the results, a series of sensitivity tests were undertaken. These included the following:

- Capital costs increased to the value of the 95th percentile estimate and decreased by 20%;
- Increased/decreased time saving benefits by 20%;
- The impact of adding Sandspit Link in 2036, and
- The discount rate of 4% and 8%.

Table 35: Sensitivity Analysis

Variable	Base case	Lower bound		Upper bound	
		Value	BCR	Value	BCR
Cost variability					
Capital Costs	$ 14.38m	+20%	11.3	-20%	7.6
Benefit variability					
Travel time savings	$ 125.86m	-20%	7.3	+20%	10.8
Sandspit Link	No	Yes	3.1	N/A	N/A
Parameter variability					
Discount Rate	6%	4%	12.8	8%	6.7

The sensitivity analysis shows that the BCR is not particularly sensitive to variations in the capital costs or travel time savings, adjusting by 2-3 points either way. Nor is it sensitive to reduction by varying the discount rate, adjusting by one point only – although a lower discount rate can considerably increase the BCR to 12.8. The largest reduction could come from the construction of Sandspit Link (not committed), which would reduce the BCR to 3.1 due to that project drawing off a substantial proportion of the travel time saving benefits.

For robustness, it is recommended that a range of BCRs is considered, between 3.1 and 9.1.

9.3 Investment Assessment Profile

The assessment profile for the project based on the Investment Assessment Framework for 2018-21 (IAF) is set out below:

- Results Alignment: High.
- Economic appraisal: BCR between 3.1 and 9.1.
- Prioritisation: between 3 and 4 (depending on the BCR).

The strategic fit and effectiveness ratings were determined in alignment with the NZTA Assessment Framework. Table 36 presents the details of the assessment of the Recommended Option against each criterion.

Table 36: Assessment Profile for Hill Street Intersection Recommended Option

Measure	IAF Criteria (2018-21)	Recommended Option Assessment
Results Alignment **HIGH**	Regional, local road and state highway improvements: A high results alignment may be given if the activity addresses the following criterion: • Supports high priority elements in agreed integrated land use and multi-modal plans	Investment in the Recommended Option is expected to realise benefits in: • Easing the constraint on the development of residential land in Warkworth to support economic growth (Benefit One, see Section 8.1.1), which is a high-priority element in the Auckland Plan and FULSS (agreed integrated land use plans). • Enabling public transport, walking and cycling to be viable choices for travel within Warkworth (Benefit Three, see Section 8.1.3), which is a high-priority element in the SGP network (an agreed multi-modal plan).
Cost Benefit Appraisal	Used to assess the efficiency of proposed investments, comparing the benefits that are achieved with the inputs (primarily costs) used to achieve the benefits	The BCR is between 3.1 and 9.1 as described in **Section 9.2**.

10 Financial Case

10.1 Project Delivery Costs

Table 37 presents a summary of the cost estimate for the Recommended Option.

Table 37: Recommended Option Cost Estimate

Description	Cost
Total physical works	$8,433,000
Investigation / Design / Construction / Mitigation	$2,150,400
Project Property Costs	$1,187,200
Contingency Allowance	$3,435,890
Total expected estimate	$15,206,490
Funding Risk Contingency	$3,175,000
95th percentile Project Estimate	**$18,381,500**

A detailed cost breakdown is provided in **Appendix J**. Key assumptions include:

- Pricing and rates are current (June 2019);
- Rates exclude GST;
- No inflation has been allowed for beyond the estimate date;
- Ground improvements have been assumed and based on mapped data;
- No specific topographical survey has been undertaken for this project. A topographical survey provided by AT was conducted on July 2016 and this information has been used;
- Earthwork quantities have been calculated from a ground model using a civil design software;
- Half cut material is assumed to be used for fill;
- An asphalt overlay of the existing pavement area within the extent of work has been included in the quantities - it is assumed that the existing road will not require total rehabilitation;
- No pavement testing has been done, quantities are based on visual inspection;
- It is assumed that the stream culvert under Sandspit Road is sound and that only lengthening would be required - further investigation would be needed to verify this;
- The effect on utility services has therefore been estimated from the sections where road widening is required;
- Retaining wall heights have been estimated from the contour plans in the areas where walls are expected;
- There is no contaminated material on-site;
- Investigation, design and construction costs have been calculated as proportion of the physical works;
- No allowance has been made for work to refresh this business case if further investigation is required;
- Incorporates allowances for barriers, signage, road marking and lighting;
- Private property costs have been excluded as it is assumed impact to private property can be avoided;

- Public land cost prices are based on rates provided by AT for mixed urban areas of brownfield; and
- Construction period of 12 months.

An indicative capital cashflow has been developed as follows:

Table 38: Indicative Capital Cashflow

Year	Pre-Implementation (Design) ($ 000)	Implementation (Construction) ($ 000)	Property ($ 000)	TOTAL ($ 000)
Year 1	$2,151	-	$1,188	$3,338
Year 2	-	$8,433	-	$8,433
TOTAL	**$2,151**	**$8,433**	**$1,188**	**$11,771**

10.1.1 Estimate Review / Parallel Estimate

A review of the cost estimate was carried out internally by AT's Commercial Quantity Surveying team as advised by the PCG. Schedule of quantities and design drawings were provided.

Upon completion of the review, a comparison between Mott MacDonald's estimate and AT's estimate was undertaken. The results of the review are included in **Appendix J** with a summary of the differences shown in Table 39.

Table 39: 95th Percentile Project Estimate

Option	Mott MacDonald	Auckland Transport	Difference (%)
Recommended Option	18,381,500	18,885,025	503,525 (3%)

The difference between the estimates is 3% so it was decided to maintain the cost estimate provided by Mott MacDonald.

10.2 Ongoing Maintenance and Operations Costs

At this stage, the ongoing maintenance and operations costs have been estimated using a high-level, top-down approach based on representative maintenance rates from current road projects, as follows:

- $11,350 annually for routine works to repaint markings;
- $30,000 every five years for minor works to refresh cycle lane markings;
- $283,750 every ten years for major works including resealing the pavement surface; and
- $737,750 every 30 years for extensive works including rehabilitation of pavement.

Assumptions as follows:

- Pricing and rates are current (June 2019);
- Rates exclude GST; and
- No inflation has been allowed for beyond the estimate date.

These estimated costs have been used as the basis for the economic analysis.

10.3 Project Revenues

Detailed analysis of potential project revenues has not been undertaken. However, the proposed investment may qualify for development contributions as any major improvement to

the intersection is expected to contribute to enabling growth in Warkworth's future urban zone. A separate process will be required to confirm this.

10.4 Funding Options

Funding for the proposed improvement to the Hill Street intersection will be considered by NZTA for prioritisation in the next National Land Transport Plan (NLTP) 2021-24. The more immediate step is for this business case to be considered by the NZTA's Delegations Committee for prioritisation in the next NLTP.

The proposed upgrade will largely affect the existing SH1 and Sandspit Road and partly, small sections of other connecting local roads such as Hill Street, Elizabeth Street, Millstream Place and Matakana Road. A special funding assistance rate (FAR) may be negotiated as part of the ongoing revocation process of the existing SH1. AT's share will be sought through the Regional Land Transport Plan (RLTP) review process.

Part D – Readiness and Assurance

11 Commercial Analysis

11.1 Introduction

NZTA is currently in consultation with AT on the proposed revocation of the existing state highway status of the section of SH1 between Puhoi to Warkworth which includes the Hill Street intersection. This stretch of road is expected to be vested to AT upon the completion of both P2Wk and MLR in late 2021.

The Commercial and Management Cases are established based on the following:

- NZTA will secure a funding subsidy for the Hill Street Intersection improvement in the NLTP 2021-24 prior to vesting of the existing SH1 (Puhoi to Warkworth) to AT;
- AT will secure local share for the project through the next RLTP review (2021); and
- The timing of delivery is post completion of MLR (post-2021).

AT has a strong long-term relationship with the construction industry in the region with particular capability to deliver large-scale and complex transportation schemes. AT also has the ability to procure and manage services required to deliver the project.

11.2 Output-based Specification

The procurement strategy will be assessed against the outcomes noted below:

- To achieve cost certainty within the available funding constraints;
- To obtain inputs, from an experienced contractor, to the construction programme so as to ensure the robustness of the implementation programme;
- To minimise further preparation costs for scheme design by ensuring appropriate quality and best value; and
- To obtain inputs, from an experienced contractor, to risk management and appraisals, including mitigation measures, to make the most of early opportunities for reducing risk in construction and to improve outturn certainty, thereby reducing risks to a level that is ‘As Low as Reasonably Practicable’ (HSE Risk Management).

The design must ensure compliance with ATCOP/TDM (latest version) or any other relevant AT standards.

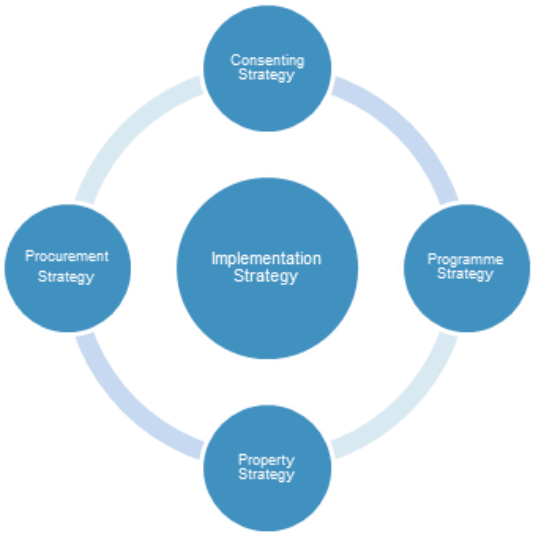
11.3 Implementation Strategy

In subsequent stages of this project an implementation strategy will be developed, setting out a proposed approach to consenting, procurement, programme and property. These will form a suite of supporting documents as illustrated in Figure 55.

The implementation strategy will set out the approach to obtain all statutory approvals necessary to enable construction, operation and maintenance of the project. It will also consider construction options for the project relative to funding availability, collaboration opportunities and government intent.

It is recommended that there is a robust pre-implementation stage to develop these strategies including considering stating options if financial constraints dictate.

Figure 55: Implementation Strategy



The primary activities to be undertaken during the next phase are:

- Funding for Project Delivery;
- Detailed Design Phase;
- The appropriate designation process;
- Resource Consents;
- Construction; and
- Project Closure

Initial considerations for the implementation strategy based on the work to date is summarised as follows:

- **Consenting Strategy:** as part of the implementation phase a consenting strategy will be prepared to provide for the regulatory approvals of the projects to be sought via an Integrated Notice of Requirement and Regional resource consent application. An initial assessment of the likely statutory requirements of the project is included in **Section 8.2.2.**
- **Property Strategy:** as shown in **Section 8.2.3**, the affected properties have a variety of zonings under the Auckland Unitary Plan: Residential, Future Urban Zone and Open Space. It is anticipated that through further investigations in the detailed design phase, land take from private properties is minimised. However, it is recommended that an immediate dialogue be commenced with all the property owners to establish their intentions and seek co-operation with AT, if required.
- **Procurement Strategy:** As part of the detailed design phase a procurement strategy for construction will be developed. This will enable the detailed design phase to target key design requirements.
- **Concept of Operations:** A Concept of Operations will be prepared for the project and developed as part of detailed design in the form of an operation and maintenance manual. It will identify the operation and maintenance requirements of the project and also consider different implementation methods depending on the overall project's implementation approach.

11.4 Risk Allocation and Transfer

The project team regularly engages in the risk management process, which includes a risk workshop to identify the risks and opportunities facing the project are identified. This is followed by identification of management controls to reduce or avoid these risks. **Appendix L** includes the outputs of the current project risk register.

The top risks for the next stages of the Hill Street Improvements project identified by the project team at this time are as follows:

- **Property / Land-Take -** There is a threat that the project is unable to purchase land in a timely manner to fit with the project programme. This will be mitigated in detailed design by refinements to avoid requirement for acquisition of private land.
- **Consenting –** There is a potential risk that the AEE determines that the environmental impact of the project may be more than minor, with consequent effects on the project obtaining the required consents.
- **Project Costs** - There is a risk that project costs increase further at the next stage of design, where the scope, standards and requirement for acquisition of land may change.
- **Funding Risk** – There is a threat that the project does not obtain funding for future stages. Without this funding commitment, implementation timing is not able to be confirmed.

During the implementation phases, AT will review and approve an implementation Risk Management Plan in accordance with the following:

- AS/NZSI ISO 31000:2009 Risk Management – Principles and Guidelines;
- AT Risk Management Framework;
- AT Project Cost Estimation Manual;
- AT Health and Safety Management Policy, Compliance Standard, Risk and Hazard Management Standard; and
- NZTA Minimum Standard Z44 – Risk Management.

11.5 Sourcing Options

There are a number of suppliers with the capability locally to deliver a project of this scale and complexity in New Zealand. The project team therefore has confidence that strong competition exists from suppliers to undertake this project.

Value for money will be achieved by developing and maintaining competitive tension in the supplier market and reducing transaction costs through business wide regional based contracts. Competitive tendering is the default method under which AT will source goods and services from medium to large-scale projects. In addition to the value of the procurement, AT will also consider the following when planning to undertake a competitive tender process:

- The scope must be clear to all parties and suppliers must know their costs of delivery.
- There must be an adequate number of suppliers.
- The suppliers must be technically competent and must actually want the work.
- There must be sufficient time for tendering.

11.6 Payment Mechanisms

The proposed project is expected to be funded through the National Land Transport Fund (NLTF) and RLTP. Payment mechanisms will be negotiated with suppliers/contractors and will

be linked to performance and availability. This will include any pricing framework and charging mechanisms.

11.7 Contract Length

Scenarios for contract length and proposed key contractual clauses will be confirmed as part of the procurement process to be undertaken by AT. These will include a programme for pre-implementation and implementation phases.

11.8 Contract Management

In conjunction with the supplier/contractor for the pre-implementation and implementation stages, AT will manage the contractual relationship, monitor the contract performance, and manage any changes to the contracts as appropriate. The contract management process will ensure that both AT's and the Contractor's performance meets the requirements in terms of the legal agreement. This will include contract and programme delivery timescales and health and safety management in accordance to AT's minimum standards and special conditions that will be included in the contract documents.

AT will be responsible for providing the programme management and scheduling tasks for the project. This will include, but is not limited to, scheduling meetings, design, consultation, consents, construction.

12 Management Case

12.1 Project Roles and Governance

The AT roles who will be responsible for the project delivery are outlined below. The Project Delivery Team will comprise of:

Table 40: Project Roles

Project Role	Responsible (AT)
Project Sponsor	Investigation and Design Manager North West
Design Project Manager	Project Manager/Engineer I&D North West
Senior User/Client	Traffic Operations Manager
Technical Specialists	Transport Modes & Urban Design Specialists Property Specialist Planner – Planning and Integration Transport Planner – Strategic Projects Traffic Engineer
Stakeholder & Communications	Stakeholder and Communications Advisor
Maori Engagement	Maori Engagement Advisor

The following governance structure (Figure 56) shows the reporting lines of the project delivery team. The responsibilities of the key roles are also outlined in Table 41.

Physical works delivery will subsequently be managed by the Road Development North West team with support from the Design Project Manager. The project structure and stakeholders will remain largely the same through to completion.

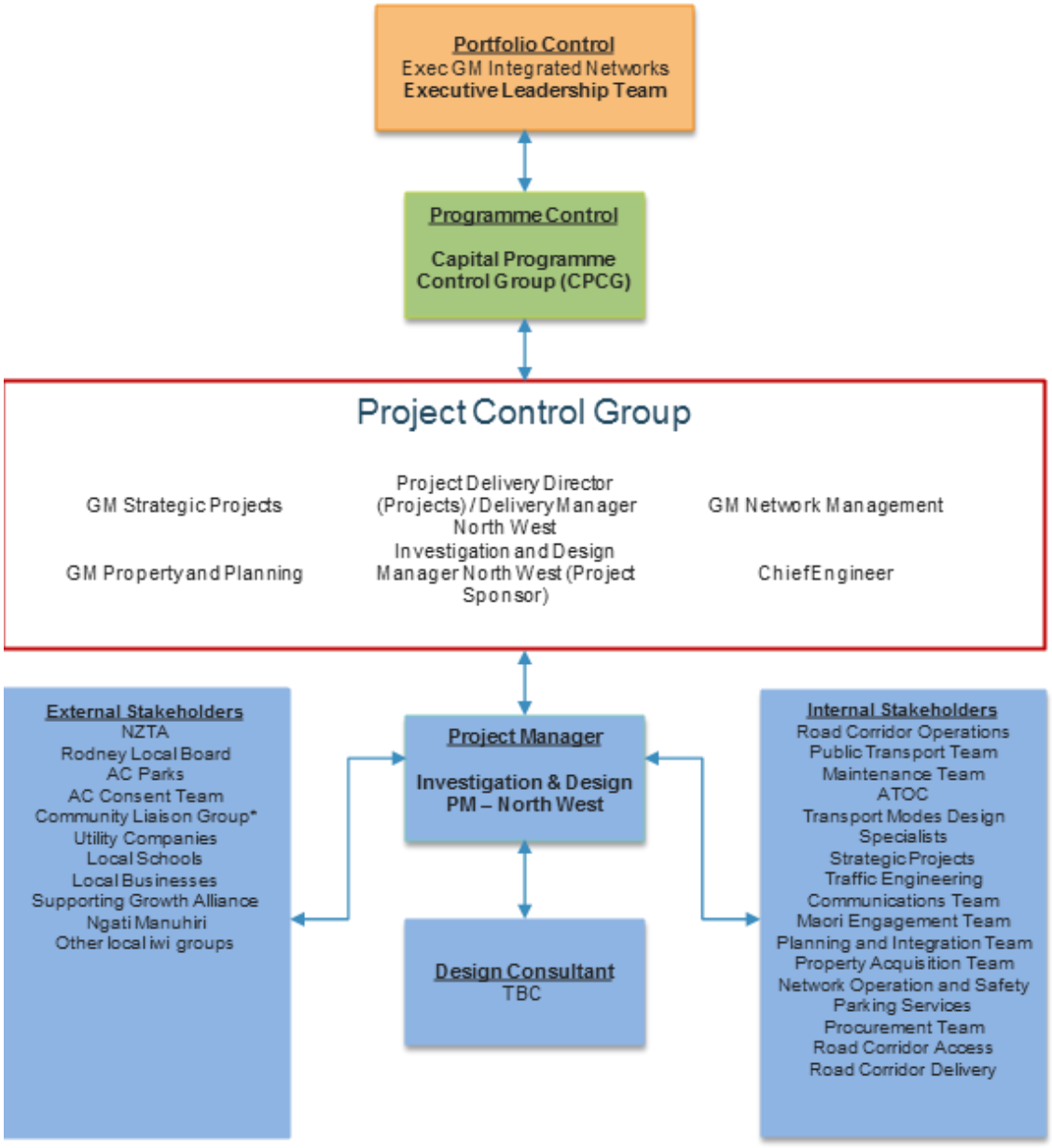
Table 41: Responsibilities of Key Project Roles

Role	Responsibility
Project Manager	In accordance with Section 3.3.1 of AT's Project Management Framework 2015 (PMF15)
Project Sponsor	In accordance with Section 3.3.2 of the PMF15, with the following exceptions: • Endorse/Approve Project Initiation Document • Endorse the project plans • Endorse the project business case • Endorse gateway approval request • Review Project Highlight Report
Project Control Group (PCG)	Project Control Groups (PCG's) are decision making bodies that ensure the right activities are taking place, undertaken correctly and are in alignment with strategic goals. The PCG provides a forum for senior management to better understand the scope, benefits and financial and contractual status of infrastructure projects, enabling informed decisions to be made and ensuring a high level of communication with stakeholders.
	The PCG will discuss any key issues or potential delivery risks that may have adverse implications for AT in terms of time and cost; or being of a high public profile / politically sensitive nature whilst ensuring a zero harm focus on project delivery is maintained. Any approvals or endorsements required that are outside of the PCG's delegated financial authority will be referred to the AT Chief Executive or AT Board.
	The PCG members are not involved in the day to day management of the project but rather set the broad direction to be implemented by the project team responsible for the delivery and administration of the project.
	The PCG will be responsible for number of approvals including: • The appointment of a Project Manager

Role	Responsibility
	• Key procurement decisions and strategies • Gateway approvals to move between phases within the project framework • Sign off on any changes to Project Plan, Business Case and Budget • Project Closure

Source: AT

Figure 56: Project Governance Structure

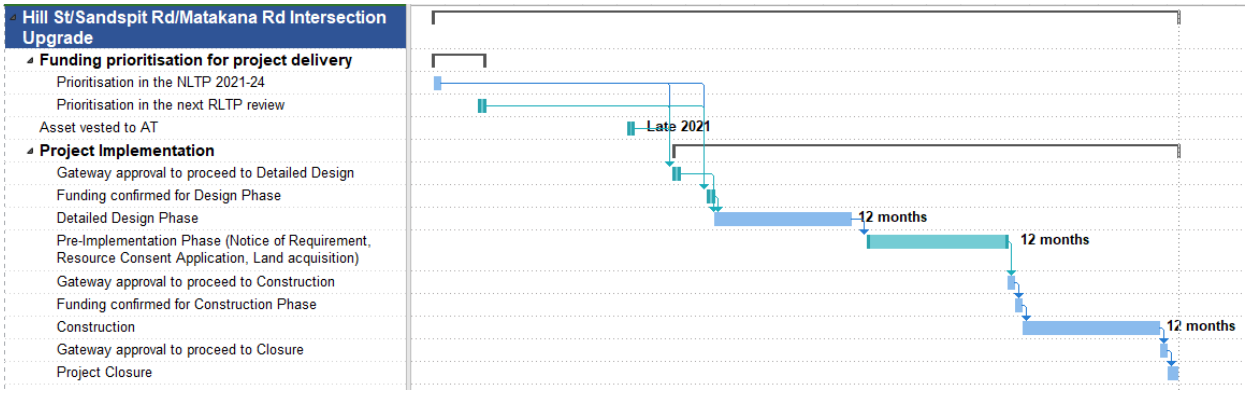


Source: AT * To replace or rename the Community Advisory Group established during the business case

12.2 Schedule

The key phases and milestones for project implementation are set out in Figure 57 below.

Figure 57: Indicative Project Schedule



12.3 Managing Risk

AT's contract managers for both the design and construction phases will undertake risk management in accordance with the AT Project Management Framework. A recommended risk register template will be used in recording project risks and escalate as necessary.

12.3.1 Risks

Key risks are outlined in section 11.4. The risk register established during this business case development is provided in **Appendix L**.

12.3.2 Assumptions

Key assumptions made as part of this SSBC are as follows:

- Completion of P2Wk and MLR as planned;
- State Highway status of SH1 in vicinity of Hill Street revoked and vested in AT;
- Development assumptions (i11);
- Patterns of travel behaviour as influenced by government policy and by technology;
- Traffic modelling assumptions (see **Appendix E**); and
- SGP networks for all modes.

12.3.3 Constraints

A number of key constraints affect the project including the following:

- NZTA Standards;
- Minimisation of SEA impacts; and
- Minimisation of private land requirement.

12.3.4 Dependencies

Project dependencies include the following.

Table 42: Project Dependencies

Dependency For / On	Potential Impact
On: Funding being prioritised in the NLTP and RLTP	May not be implemented

Dependency For / On	Potential Impact
On: Completion of both P2Wk and MLR and subsequent revocation of SH1	Timing of delivery start will be pushed out
On: Required consents being obtained for implementation.	Consents not obtained. Re-design required

12.4 Contract Management

The Contract Manager will generate a base lined schedule to monitor the supplier's progress and ensure that AT provides the required information/deliverables at the right time.

There should be at least two schedules in place:

- The Contract Schedule which is usually explicitly defined in the terms of the contract.
- It may happen that there is some float in the contract schedule. Unless stated otherwise in the contract it should be assumed that the supplier owns the float and if AT or the Principal delays the contractor in completing the works, then generally he is not entitled to deduct any liquidated damages for that delay.
- The Project Schedule which may have its own float. This will not normally be accessible to a particular contract. If, for whatever reason, it is drawn on by a contract, it will be the result of a variation or other significant event, and will have broader ramifications that need to be managed.

12.4.1 Change Control

Where changes become necessary during the period of the contract, a formal variation will be clearly documented by the Contract Manager and approved by the relevant delegated authority. Variations can be within the agreed contract fee or that entitle the supplier to additional payment or extensions of time. Variation claims will be supported by evidence with the onus on the claimant to prove entitlement in the first instance. Any potential or actual change will be recorded and assessed on a variation assessment form.

Depending on the scale of the variation and its impact on the overall phase of the project, Change Control process may need to be followed by the Project Manager which may require a Cost-Scope Adjustment.

AT's "Engineering Professional Services Contract", clause 7, describes the contractual obligations around variations for professional services under this contract.

For physical works contracts NZS3910 (2003) clauses 9.1 to 9.3 and section G9.1 to G9.3 set out the detail around when variations are permitted and how they should be valued. NZS3910 (2003) also contains a chapter called "General Aid to Valuation of Variations" which provides work examples and a flow chart to assist with the valuation of variations.

12.4.2 Cost Management

AT have a process in place for managing contract finances. This includes cashflow monitoring and forecasting.

The Contract Manager will track actual spend and forecast future spend using the Forecast and Expenditure Tool (SAP BPC forecasting) to monitor and control the contract budget. Contract cash flow monitoring and forecasting will help the Project Manager to track and forecast the overall project spend profile. This forecast spend profile is updated in the CJR2 report of SAP once a month before the Project Highlight Report is submitted.

In order to maintain an accurate assessment of cash flow, the supplier will need to complete their forecast regularly (at least monthly).

Where quantity surveyors are used for physical works contracts, they should submit a monthly financial report including a forecast cost to complete.

The Contract Manager will manage the contract to try and remain within budget. Early warnings of risks to the contract budget will be escalated and any budget changes should be actioned in accordance with AT's Contract Change process.

12.5 Issues Management

The Contract Manager will undertake issues management in accordance with the AT Project Management Framework. Issues impacting on the project should be discussed with the Project Manager, recorded in the project issue log and escalated as necessary. The recommended issues log template will be used.

12.6 Quality Management

AT have established a practical approach to the management of quality within its infrastructure projects and is committed to the application of good quality management principles and practices in infrastructure projects. The following will be required for each relevant stage of the project to which the Contract Manager should monitor the contract/s to ensure that it complies with the approved plans:

- Project quality plan;
- Site management plan for physical works; and
- Environmental management plan for physical works.

These will be specified in the contract specifications to be prepared by consultants/contractors.

12.6.1 Acceptance

Quality control and audit processes will be established for the project. This may involve formal reviews with Sponsor and/or Business Owner, review by specialist legal, procurement or health and safety advisor, confirmation by financial advisor or other mechanism.

Gateway reviews will always be conducted by Project Sponsor and business Owner. These are scheduled for the conclusion of all project management phases as defined in AT's PMF. Reviewers are responsible for the sign off or acceptance of deliverable.

Reviews and audits will be conducted, particularly on high risk projects. These are either undertaken by Risk and Audit staff directly or through engagement of external experts. External audits are conducted to provide assurance to AT Executive and Board regarding major project and programme investments.

12.6.2 Peer Reviews and Audits

For this business case, an independent peer review process has been set up to ensure the project is in a good state of health. Reviews were undertaken at various stages of the business case process. Documentation related to the peer reviews and audits conducted to date is attached in **Appendix M.**

A Stage 1 Road Safety Audit (RSA) on the recommended design was completed by Harrison Grierson (HG) in July 2019. The designs were amended in response to the issues identified, and the road safety was signed off by AT in August 2019.

The draft concept design drawings were circulated for internal review within AT in June 2019. Responses to consultees have been provided, and some changes have been made to the design as a result. A full set of drawings is provided in **Appendix I.**

Flow Transportation Specialists conducted a peer review of the SSBC in July 2019. The review focussed on the traffic modelling and economic evaluation. Flow raised concerns that the BCR could be overstated and made recommendations for improvements of the economic evaluation. As a result of the review, a review of the modelling for the recommended option was undertaken and the economic evaluation updated. Further details on the economic evaluation can be found on **Section 9** and **Appendix K**.

For subsequent stages of this project, internal peer reviews will be carried out on all deliverables submitted by consultants/contractors. External peer reviews will be carried out as a minimum in accordance with NZTA's guidelines.

Road safety audits will be undertaken following NZTA's 'Safer Journeys - Road Safety Audit Procedures for Projects' guidelines. Safety audits will be undertaken at project milestones as follows:

- Concept stage (part of a business case) – safety audit was undertaken for this business case and is attached in **Appendix M**.
- Scheme or preliminary design stage (part pre-implementation).
- Detailed design stage (pre-implementation or implementation).
- Pre-opening or post-construction stage implementation or post-implementation).

AT will procure Independent safety auditors separately at each project stage described above.

12.7 Tolerances

Figure 58 defines the project tolerances and the corresponding colours established by AT in its Project Highlight Reports and dashboard reports. The Project Sponsor is expected to set the overall status (colour) of the project following review.

Figure 58: Project Tolerances Definition

Item / Colour	RED	AMBER ←	GREEN ←	Item	GREEN →	AMBER →	RED
Zero Harm	Fatal injury	Minor injury	No injuries	Contractor monthly return	No near misses	Need to address compliance	High level non compliance
Scope	Change Required	Risk of Scope Change	No change	Scope	No change	Risk of Scope Change	Change Required
Budget	Outside Range	2.5% or $25,000 less than forecast	1% or $10,000 less than forecast	Expenditure	1% or $10,000 more than forecast	2.5% or $25,000 more than forecast	Outside Range
Milestone	Outside Range	4 weeks from milestone	1 week from milestone	Progress to date	1 week from milestone	4 weeks from milestone	Outside Range
Issues	Outside Range	3 pending issues	All issues closed	Issues Log shows	All issues closed	1 open issue	Outside Range
Property	Property acquisition issues threatening project deliverables	Some pending issues that may threaten project objectives	No Issues, properties aquired	Property Aquisition	All issues closed	Minor issues pending	Enviromental court action
Consents	Concents withheld threat to project	Manageable issues exist	All consents Identified and applied for	Consents Register	Consents applied and granted	Minor issues to update and resubmit	Consent not granted
Risks	Outside Range	2.5% or $25,000 less than forecast	All risks mitigated	Risk Log shows	All risks mitigated	2.5% or $25,000 more than forecast	Outside Range
Overall	To be set by the Sponsor/Director following the project review						

Source: AT

The Project Manager will monitor the performance of the project, in relation to tolerance limits, through the provision of accurate performance data. The collation of this data is fundamental to accurate project monitoring and reporting. These tolerances can be modified through a change process.

12.8 Lessons Learned and Post Implementation Monitoring

12.8.1 Lessons learned

Lessons learnt from this project will be fed back into both AT and the NZTA's project development and delivery lifecycle through a number of different mechanisms and levels of project management. These include a Lessons Learnt Review (LLR) and Contract Management Review processes.

While planning, the project team reviews the results of past projects. This prevents similar projects from making the same mistakes. The team evaluates its own successes and failures and records them in a Lessons Learned Database.

The Project Manager is accountable to review the project lessons learned data provided to the team and facilitate how to improve project management methods and productivity. This provides an opportunity for the team to take effective action and have control over future performance that are anticipated to increase job satisfaction, moral, and ability to take joy in work.

12.8.2 Post implementation monitoring - approach and schedule

The Hill Street Intersection Improvement project objectives and proposed KPIs are presented in **Section 8.1.4**. These will be monitored in a continuous process as the project progresses through detailed design, construction and operation.

A Benefit Realisation review (formerly known as Post-Implementation Review or PIR) is recommended to be conducted at least 3 years from implementation. The PIR report will outline any changes or progress against the base KPIs and investment objectives determined during this business case and measured prior to implementation.

Appendices